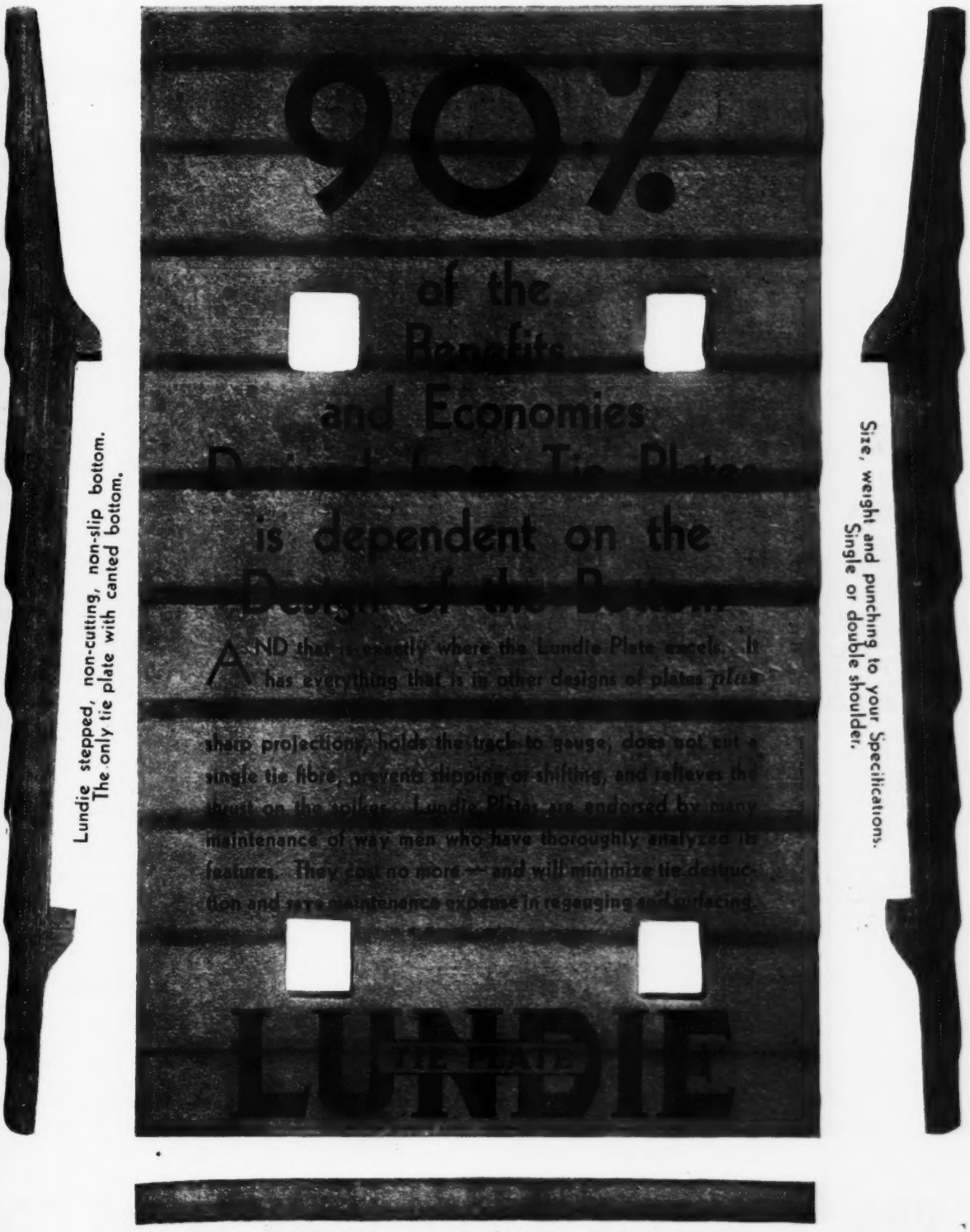
Railway Engineering and Maintenance

November, 1934

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 35 cents. Entered as second class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

The Only Essentially Flat Bottom Tie Plate that Holds Gauge.



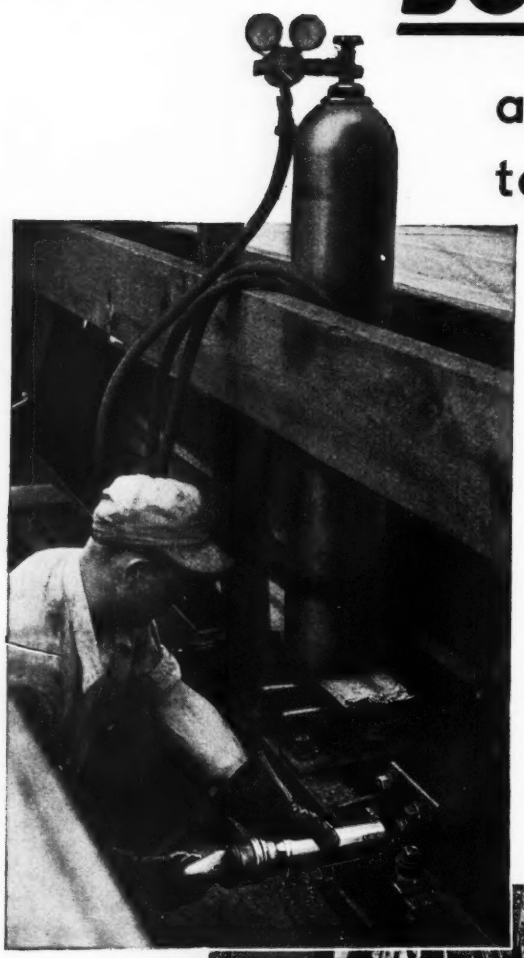
Cambered to prevent rocking of the plate on the tie.

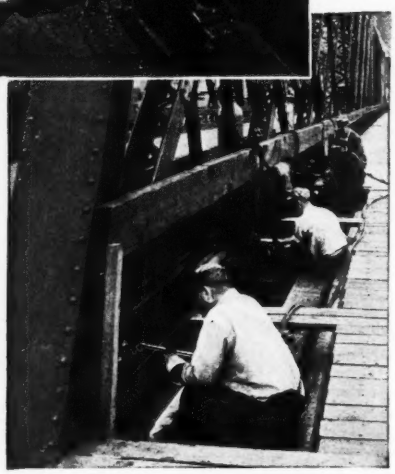
THE LUNDIE ENGINEERING CORPORATION

285 Madison Avenue, New York 59 East Van Buren St., Chicago

"BOTTLED POWER"

another AIRCO contribution to **economy** for **railroads**





The simplicity and convenience of AIRCO BOTTLED POWER for rivet replacement work is clearly evident in this typical bridge repair scene. Note cylinders entirely in the clear.

- **SUBSTANTIAL SAVINGS in the maintenance of riveted steel work on bridges, buildings and other fabricated structures are made possible by BOTTLED POWER—an AIRCO inert gas available in conveniently handled cylinders at 2000 pounds per square inch pressure.**

By providing a source of power for operating standard pneumatic riveters and drills, in units that are easy to handle and inexpensive to transport and set-up, AIRCO BOTTLED POWER serves as a positive time, labor and money saver in the following situations:

1. **For replacement riveting and drilling on jobs involving 100 rivets or less where the heavy expense of transporting and setting up a compressor would be prohibitive. Worth while savings have been made with AIRCO BOTTLED POWER on jobs up to 500 rivets.**
2. **For riveting and drilling on bridge towers and other elevated structures, avoiding the high cost of piping for compressed air. In such cases the use of AIRCO BOTTLED POWER is not confined to small unit jobs, but is a valuable adjunct to the compressor on large repair jobs and new construction as well.**
3. **For riveting and drilling in constricted areas where lack of space limits the use of a compressor and makes hand operations impracticable.**
4. **For riveting and drilling where work must not interfere with traffic. The compact AIRCO BOTTLED POWER cylinder can be slung in the clear, allowing work to proceed without interruption.**

Get the Full Details

AIRCO'S RAILROAD DEPARTMENT is ready to supply Railway Maintenance Engineers with complete BOTTLED POWER details, including actual cost and savings data from railroads that are already capitalizing its possibilities.

NRA MEMBER U.S. WE DO OUR PART

AIR REDUCTION SALES CO.

General Offices: 60 East 42nd St., New York, N. Y.

DISTRICT OFFICES and DISTRIBUTING STATIONS in PRINCIPAL CITIES

Today, as always, roadbeds must be maintained to insure safety of railroad transportation. More than ever before, the cost of such maintenance must be kept to a minimum.

Railroads have found the answer to this problem in Toncan Iron Corrugated Pipe—and the answer is ease of installation, high strength, long life and genuine economy.

Toncan Iron Corrugated Pipe is light in weight, easy to handle and is available in long lengths with a complete line of fittings. It possesses the inherent strength to withstand tremendous superimposed loads, and the necessary flexibility to adjust itself to external and internal natural forces. Traffic vibrations and shrinkage of embankment do not affect its soundness. And because Toncan Iron is a highly refined open hearth iron with which are alloyed correct proportions of copper and molybdenum, it possesses the maximum rust-resistance of any ferrous material in its price class. It lasts where other structures fail.

Write for the Toncan Iron Corrugated Pipe Handbook—it will show you how to reduce costs—with Toncan Iron Corrugated Pipe.

TONCAN CULVERT RAILWAY SALES
310 South Michigan Avenue, Chicago, Ill.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION, YOUNGSTOWN, OHIO

PUTTING THE BRAKES ON RUST...

Dutch Boy Red-Lead is a highly oxidized red-lead supplied in two forms — paste and liquid. The paste comes in natural orange-red, is readily mixed to brushing consistency, can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) comes in the natural orange-red, two shades of brown, also in black.

Nothing protects metal like Red-Lead and "Saucer Test" proves it

ARE YOU one of those responsible for the care of iron and steel structures? Are you connected with a steamship company, a railroad, an oil or gas company, a highway department or any other organization with large areas of metal to be kept in A-1 condition?

It is for men in your position that we have developed the "Saucer Test", a simple, practical way to demonstrate which paint gives metal structures the most durable and economical protection.

The "Saucer Test" Kit comes to you free . . . just send coupon below. Includes metal saucer and sample of Dutch Boy Red-Lead to test against any other paint you wish. Choose your own conditions. Test under sun, heat, cold, moisture, smoke, fumes, salt air, water.

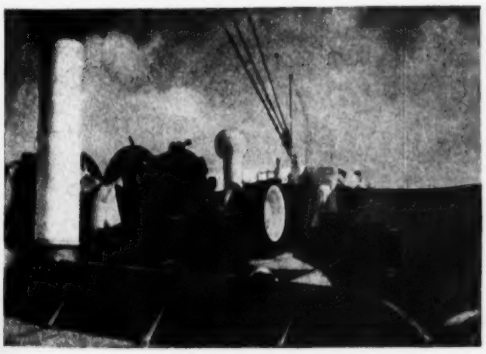
In a long series of tests conducted by a leading southern railroad, the "Saucer Test" proved that pure red-lead outlasted other paints tested as a primer by 4 to 1.

But don't take our word for it or the word of others. Put red-lead *on the spot* yourself. Send for the KIT and see the evidence with your own two eyes . . . how pure red-lead gives long-life protection and saves money.

NATIONAL LEAD COMPANY

111 Broadway, New York; 116 Oak St., Buffalo; 900 W. 18th St., Chicago; 659 Freeman Ave., Cincinnati; 820 W. Superior Ave., Cleveland; 722 Chestnut St., St. Louis; 2240 24th St., San Francisco; National-Boston Lead Co., 800 Albany St., Boston; National Lead & Oil Co. of Pa., 316 4th Ave., Pittsburgh; John T. Lewis & Bros. Co., Widener Bldg., Philadelphia.

DUTCH BOY RED-LEAD



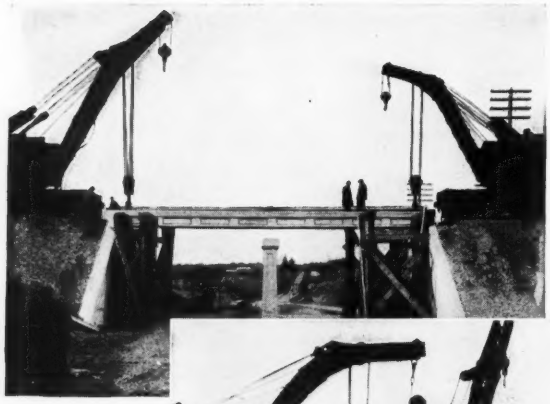
NATIONAL LEAD COMPANY
Please send *free* kit for making the "Saucer Test" REM-11-34

*Individual's Name and Title*_____

*Firm Name*_____

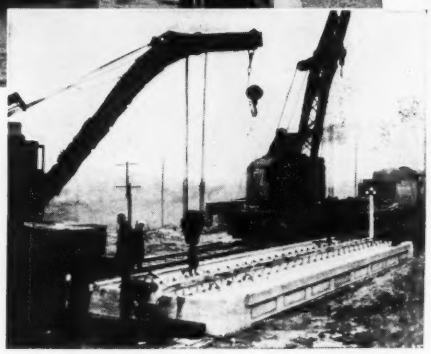
*Street*_____

*City*_____ *State*_____



Right: 160 and 100 ton capacity cranes ready to lift concrete slab.

Above: Concrete slab being placed in position.



WHERE ACCURACY COUNTS AND DEPENDABILITY, TOO

The Canadian National Railways, like practically all railroads, use Industrial Brownhoists. Recently, two of their cranes were used in erecting a pre-cast concrete bridge—a difficult job, but one which saved a prolonged diversion of traffic . . . and a lot of money.

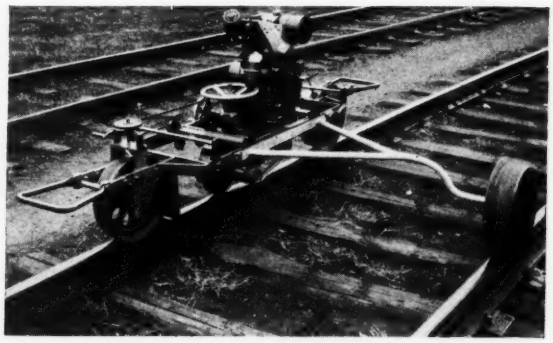
The engineers of this road, commenting on their Industrial Brownhoists, say: "This particular work involved the lifting at the casting yard, traveling several hundred yards with the load and placing two concrete slabs, each weighing 79 tons and 58 feet 10 inches long. These two slabs were lifted individually, accurately placed and fitted alongside each other without damage or hitch."

Few executives realize the savings which a good locomotive or crawler crane will effect on their work. But most Industrial Brownhoist owners admit freely that they could not get along without them. May we tell you why?

INDUSTRIAL BROWNHOIST CORPORATION
General Offices: Bay City, Michigan
District Offices: New York, Philadelphia, Cleveland, Chicago

INDUSTRIAL BROWNHOIST

THE COMPLETE LINE OF LOCOMOTIVE AND CRAWLER CRANES

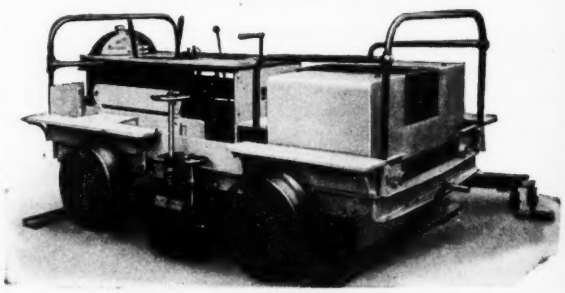


Model P-15, Portable Track Grinder, Gasoline Engine Driven—one of many models.

Maintenance Budget Stretchers

Make track-maintenance dollars do double duty with more efficient equipment. For economy in rail grinding, come to world-headquarters for rail grinders. There's a model to meet your conditions and your ways of working, for every rail grinding job. Latest models, gasoline, or electric, mark a long step forward. Write for newest literature showing the complete line.

Railway Track-work Co.
3132-48 East Thompson Street, Philadelphia



Model P-7, one of many.

997

NO FROZEN SWITCHES WITH WINTER KINGS ON THE JOB

The Winter King Switch Heater is made of copper-bearing steel. The fuel chamber contains about 1½ gals., sufficient for about 9 hours of ordinary operation. A flange on each side of the wick opening maintains the proper distance between the heater and the bottom of the switch point. Heaters are shipped with the wick installed, ready for immediate use. It is only necessary to place the heater beneath the switch point, fill the fuel chamber with kerosene and light the wick.

Now is the time to install Winter King Switch Heaters under all important switches. Then let the blizzards come. They'll find the vulnerable points of the system thoroughly protected. Winter Kings prevent nearly all of the trouble from moderate snowfalls and make it a lot easier to keep terminals open in heavy storms.

Winter King Switch Heaters are not only thoroughly effective, but economical as well. It costs very little to operate these heaters as compared with other methods of snow removal. One man can tend efficiently about 100 heaters. A single filling of kerosene lasts about 9 hours.

With Winter Kings in place it's easier to forestall the effects of a sudden snow or ice storm. It's so little trouble and expense to send a few men out to light up the heaters when the storm begins, while there's a natural tendency to avoid getting a large crew on the job for manual cleaning until actual trouble makes it necessary. Another advantage in using Winter Kings lies in avoiding the risk of accidents that goes with having a large number of inexperienced men at work in the yards.

Winter Kings installed now will prevent a lot of grief later on.

BETHLEHEM STEEL COMPANY

District Offices: Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Washington, Wilkes-Barre, York. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles Portland, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

GENERAL OFFICES: BETHLEHEM, PA.

BUDGET MAKING TIME

Maintenance Mike Says—"The time to advertise for 1935 business is before the programs are completed—not after."

With the arrival of frost, much of the year's work on tracks and structures is drawing to a close.

Maintenance officers are now completing their fall inspections to determine what they will do and what they must do next year.

Five years of under-maintenance cannot be ignored. Neither can the increasingly exacting demands of tomorrow's traffic—to say nothing of the necessity for making good current wear and tear.

Whether next year's business is good or bad, the railways must buy maintenance of way materials and equipment.

They brought $150,000,000 worth this year. They will buy at least as much next year—probably more.

Their problem is one of selection, for their needs are so great that even under the most favorable conditions they cannot purchase all of the materials that they need.

Are you, Mr. Manufacturer, telling the story of your products to those sub-division, division and system maintenance officers who are now beginning to lay out their programs for next year and selecting the materials, tools and equipment needed therefor?

In other words, will YOUR products be near the top of their lists?

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

CB SECTION PILES in 6 more bridge jobs

1 **KANSAS RIVER BRIDGE**
Kansas City, Kansas

335 piles, 12″ CB sections, 37 to 81 ft. long, driven into heavy shale to resistance of 25 blows per inch of penetration under No. 1 Vulcan Hammers.

2 **MISSOURI RIVER BRIDGE**
at Elbowoods, North Dakota

150 straight and batter piles, 14 to 40 ft. long, driven to resistance under No. 1 Vulcan Hammer of at least 30 blows per inch, in Pier No. 2, and to refusal under 300 to 2400 blows with 3 piles showing no movement after 25 to 48 minutes continuous driving on 12″ CB sections in Pier No. 3.

3 **GREAT MIAMI RIVER BRIDGE**
Dayton, Ohio

900 piles, 10″ CB sections, 24 to 60 ft. long, driven into gravel and hardpan to resistance of 3 to 7 blows per inch under No. 1 Vulcan Hammer. Character of gravel such that it was impossible to get more than 8 or 9 feet of penetration with either concrete or wood piles, while 10″ CB's were driven with ease.

4 **MERAMEC RIVER BRIDGE**
15 Miles South of St. Louis, Mo.

Approximately 20,000 lineal ft. of 10″ CB sections furnished in 40 and 60 ft. lengths, spliced by welding, and cut to lengths required, and driven to rock.

5 **BLACK RIVER BRIDGE**
at Hendrickson, Mo.

107 piles, 10″ CB sections, 43 to 75 ft. long, driven through layers of sand with clay, sand and gravel, cemented gravel, and sand and coarse gravel to resistance of ⅛″ to ⅜″ penetration per 100 blows of 9-B-2 McKiernan-Terry Hammer.

6 **BLACK RIVER BRIDGE**
at Leeper, Mo.

132 piles, 10″ CB sections, 16 to 94 ft. long, driven through sandy loam, sand and gravel, boulders and ledges of soft brown limestone to resistance of 0″ to ⅛″ per 100 blows of 9-B-2 McKiernan-Terry Hammer. On 16 of the shorter piles a Vulcan Hammer gave penetrations ranging from 0″ to ¾″ per 100 blows at end of driving.

The popularity of CB Sections as bearing piles is rapidly growing. Engineers and contractors who have been *forced* to use CB's because they could not secure the necessary penetration with other types of piles have invariably included them in their initial designs on later projects. The excellent performance and economy of these sturdy wide-flange steel sections will make an enthusiast of you, too, if you will give them a chance. Our engineers would like to acquaint you with some interesting facts and figures.

CARNEGIE STEEL COMPANY · PITTSBURGH
Subsidiary of United States Steel Corporation 282

CB SECTION BEARING PILES

STATEMENT of the ownership, management, circulation, etc., required by the Act of Congress of March 3, 1933, of RAILWAY ENGINEERING AND MAINTENANCE, published monthly at Chicago, Illinois, for October, 1934.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the RAILWAY ENGINEERING AND MAINTENANCE and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form,to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Simmons-Boardman Publishing Co., 30 Church St., New York, N. Y.
Editor, Elmer T. Howson, 105 West Adams St., Chicago, Ill.
Managing Editor, Walter S. Lacher, 105 West Adams St., Chicago, Ill.
Business Manager, F. C. Koch, 30 Church St., New York, N. Y.

2. That the owners are:
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ELMER T. HOWSON,
Editor.

Sworn to and subscribed before me this 27th day of September, 1934.
ANNE A. HOYD.
[Seal] (My commission expires Dec. 10, 1935.)

No. 71 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Public Interest in Railroads

October 25, 1934.

Dear Reader:

When you were a boy, I am sure that you passed through the period, as I did, when your one ambition was to be a locomotive engineman. At that stage in your boyhood, every locomotive, small though it was in comparison with those of today, was a source of intense interest and every train provided a thrill. Yet today there are those who say that the railroads are obsolete and the public is no longer interested in them. Do you believe that this is true?

The reception which the public has accorded the streamlined trains of the Union Pacific and the Burlington during the last summer provides an answer. As these trains toured the country, schools and stores were closed and crowds everywhere greeted them. Likewise, when displayed at the Century of Progress exposition at Chicago, these trains have "stolen the show" with the result that to date more than four million people have passed through the Union Pacific train and nearly two million through that of the Burlington.

Still another illustration of this interest came to my attention during the month. A few minutes prior to the opening of the convention of the Roadmasters Association, a newspaper reporter approached me for a "story" about the convention. Realizing that there was little of interest to the general public in the more or less technical reports that were to be presented, I told him that the public interest in this meeting lay in the fact that the men in attendance were those on whom rested the responsibility for the preparation of the tracks over which the high-speed streamlined trains were to run on the various railways, and listed for him those roads which had already ordered or announced their intention to order such trains.

That evening, the newspapers in Chicago carried reports of this interview, correct in part, but inaccurate and exaggerated in numerous details. A few days later, clippings began to come in from newspapers throughout the country, until nearly 125 have now been received from papers with a total circulation of approximately seven million, and they are still coming in, evidencing in another way the widespread public interest in the railways.

No, I am sure that you will agree with me that the public has not lost its interest in the railways. On the contrary, we can be proud of the fact that we are in an industry that is very much alive and that is going places today.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor.

MEMBER: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

HIPOWERS

A STRAIGHTFORWARD PROPOSAL

We have sold millions of Hipower spring washers to the railroads. These Hipowers have saved millions of dollars for the roads and for their stockholders. ● We manufacture spring washers that are designed for each and every track use. ● So we feel justified in proposing that you let representatives of our engineering and sales departments discuss possible increases in savings for your road.

BEFORE ORDERING CONSULT OUR ENGINEERING AND SALES DEPARTMENTS

THE NATIONAL LOCK WASHER COMPANY

NEWARK, NEW JERSEY, U. S. A.

Published on the last Thursday preceding the month of issue by the

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932 National Press Bldg.

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Member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.)

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

November, 1934

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Managing Editor

NEAL D. HOWARD
Eastern Editor

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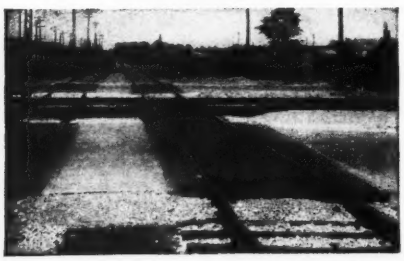
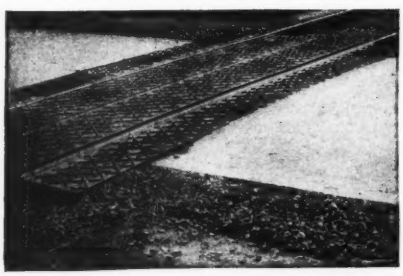
Here's a crossing that will stay put

—at track level

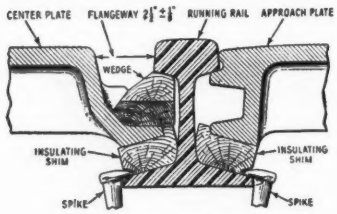
NRA MEMBER
CODE
RAILROAD SPECIAL TRACK EQUIPMENT MANUFACTURING



Detroit Terminal R. R. Co., Oakland Blvd., near Grand River Ave., Detroit, Mich.



Rock Island, Ponca City, Oklahoma.



Section at running rail

Three features distinguish

RACOR UNIVERSAL PERMANENT HIGHWAY CROSSINGS

1st.—They stay PERMANENTLY at track level, because the plates are supported by the BASE OF THE RAILS and therefore always follow the rail level.

2nd.—They are indestructible, more so than high test manhole covers, and will stand up for over twenty years under any traffic allowed on public roads. The individual plates are easily handled, easily installed or removed. They are toe checked on top to prevent skidding and heavily ribbed on the underside for *strength*. No special track preparation needed to put down.

3rd.—A metal non-skid highway with effective insulation between the R. R. running rails.

In short, the hundreds of crossings equipped with these plates prove beyond question that the original installation is practically the LAST COST, in spite of heaviest traffic, frost or other elements that play havoc with less permanent forms of construction.

Why not visit an installation near you? That's the BEST PROOF. Write us — and we'll be glad to advise location.

RACOR TRADE MARK REGISTERED

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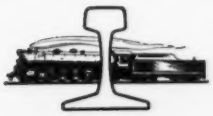
Railway Engineering and Maintenance



A PROGRAM

Railways Formulate Policies for Aggressive Action

WITHIN the past month the railways have initiated an aggressive campaign for the solution of their problems that means much to their future prosperity. This action is of equal importance to railway employees, whose prosperity depends on that of their industry. It is important, therefore, that every employee have a full understanding of the railway problem in its various phases in order that he may be able to interpret to those with whom he comes in contact the measures which the railways are now initiating for its solution.

The Problem

The acuteness of the railway problem is best indicated by the decline in income. In 1929 total operating revenues of the Class I railroads (those with revenues exceeding $1,000,000 annually) amounted to $6,279,500,000. In 1933 these revenues had shrunk to $3,095,400,000, a loss of more than 50 per cent. As a result, net income (the amount left after the payment of operating expenses, fixed charges, rents, etc.), declined from $896,800,000 in 1929 to a deficit of $13,800,000 in 1933. Likewise, while railways comprising 4 per cent of the mileage failed to earn their operating expenses and fixed charges in 1929, this proportion increased to 58 per cent in 1933 and to 67 per cent in 1934. On those roads which failed to earn their fixed charges in 1933, the total deficit aggregated $153,000,000. Furthermore, 26 roads with more than 40,000 miles of lines are now in receivership or trusteeship.

This situation has been made more acute within recent months by increases in expenses forced on the railways by conditions beyond their control. Foremost among these increases are those brought about by rising costs of materials resulting from the NRA codes. Thus, coal is costing 29.5 per cent more this year than a year ago; crossties are 23.6 per cent higher and lumber prices have increased 54.2 per cent. Increases such as these in the unit costs of almost all of the materials which the railways use, without any allowance for greater consumption, are estimated to be adding $137,000,000 to the operating expenses of the railways annually. Likewise, the restoration of the basic rates of pay that are being made effective in three installments are adding $156,000,000 to costs, while the new pension bill is estimated to add some $66,000,000 to the amounts which the railways are now spending for that purpose. All told, the added costs to which the railways are now being subjected by reason of higher prices for the materials which they consume, increases in wages and added payments for pensions, will total considerably in excess of $300,000,000 per year.

A Three-Fold Program

Faced with this situation, the railways have undertaken a three-fold program for relief. The first step is a request for higher rates, hearings on which opened before the Interstate Commerce Commission on October 1. Contrary to past practice, the increases which the railways are now requesting are not all-inclusive or uniform, but are being applied only to those commodities which are believed to be best able to bear them. The increase requested approximates 7 per cent, as compared with an average decrease of 7.3 per cent that has actually taken effect during the years 1930-33 and a decrease in 1933 of 21.8 per cent as compared with 1921. These increases, if made effective, will add about $170,000,000 to the income of the railways or sufficient to offset less than 60 per cent of the added expenses to which they have been subjected during the last year. It is evident, therefore, that the railways must also look still further for relief.

Legislative Aid

The second step in their three-fold program contemplates an appeal to Congress for legislative aid to bring competing highway and waterway carriers under federal regulation and thereby equalize competition. It is self-evident that no branch of an industry that does two-thirds of the business of that industry under strict governmental supervision and regulation can compete with any degree of success for the remainder of the business with operators that are free of all such restrictive regulation. For this reason, the railways are pressing for legislation that will extend to commercial transportation on the highways the same measure of regulation as to rates, certificates of convenience, hours of service, accounting, reports, taxation and the like that the railways are now subjected to. Such a policy has been recommended by the Federal Co-ordinator of Transportation, by the Interstate Commerce Commission, by the National Association of Railroad and Utilities Commissioners, by the representatives of organized labor, by a considerable number of common-carrier motor truck operators and by many chambers of commerce. Similarly, the railways urge that carriers operating on coastal and inland waterways be brought under regulation as to rates, services, etc., comparable with the railways. Furthermore, they

believe that it is essential to orderly legislation that the regulation of all of these agencies be entrusted to the same body, for it is only in this way that there can be uniformity in procedure and equitable treatment.

Withdraw Subsidies

As a further step in their legislative program, the railways contend that the subsidies now given to highway and water transportation should be withdrawn by the imposition of taxes or tolls in amounts sufficient to defray the interest on the investment of public funds made for these facilities for their benefit, as well as for the maintenance of these facilities. On the highways, for illustration, commercial buses and trucks are making necessary heavier construction and heavier maintenance expenditures than would be required for passenger and other local vehicles. One measure of the inequality of the present situation is the fact that the railways are required to pay out for interest on their investment in roadway and for its maintenance more than 25½ cents of every dollar taken in. If to this sum there be added the taxes paid by the railways for general governmental purposes, the total is increased to 34½ cents. Motor transport agencies, on the other hand, do not pay out in gasoline and other taxes more than 6 cents of every dollar of their revenues.

Likewise, on the waterways, the vast investment of public funds in the construction and maintenance of channels, in harbor development, etc., is turned over to the water carriers with little or no tolls. In addition to endeavoring to correct this inequality, the railways are also contending that the federal government should withdraw from competition with them through its federal barge lines, a sufficient time having elapsed to complete the experiment and determine the feasibility of commercial operation on the inland waterways.

As a further development in their legislative program, the railways are asking for the modification of the long-and-short-haul clause of the act to regulate commerce to enable them to compete with the Panama canal lines for traffic to and from the west coast without breaking down their rate structure to intermediate points. While this measure is of primary importance to the transcontinental lines, its restrictive effect in obtaining business is felt by railroads throughout the country.

Eliminating Wasteful Competition

As a third step in their program, the railways are attempting to so co-ordinate their own activities as to eliminate wasteful competition. To give effect to this objective, they have organized the Association of American Railroads to take over the policy-making functions of the Association of Railway Executives and the more strictly operating activities of the American Railway Association. This new organization, which was set up on September 21 and is now in process of acceptance by the individual railways, will provide a more aggressive agency for attack on problems common to the various railways and for the "more perfect union" of the railways for which the Federal Co-ordinator of Transportation has been contending. To this organization is given broad powers by the individual railways to speak and act for them and also to curb wasteful competition.

By these various measures, coupled with alertness in meeting competition and improving service through such measures as the air-conditioning of passenger trains, the development of high-speed streamlined trains, the reduction of passenger fares, the speeding up of freight and passenger service and other improvements that are now in the making, the railways are pressing more aggressively for their rightful consideration as the country's primary and most essential agency of transportation. To be efficient, such an agency must enjoy a reasonable degree of prosperity. The measures that are now being advanced by the railways are designed to bring about that condition. As such, they merit the full co-operation of every railway employee in so informing those with whom they come in contact in their respective communities regarding the facts that these persons may in turn aid in developing an enlightened and sympathetic public sentiment with respect to these measures.

SWITCHES

Fall Inspection Is Particularly Important

WHILE the regular inspection of switches is one of the important duties of both section foremen and supervisory officers, the late fall inspection is especially important since it affords the final opportunity to take action on needed repairs and adjustments before winter sets in. Turnouts that have been put in first-class shape at this time should carry through until spring with only minor attention, while those that are allowed to enter the winter in poor condition will be a continual source of trouble and a potential cause of accident.

One of the items that should be given particular attention at this time is that of drainage, since it has an important bearing on the performance of the switch during cold weather, especially during periods of alternate freezing and thawing. Yet strangely enough this is frequently neglected or only imperfectly provided for.

It is true that in many instances it is difficult to provide satisfactory drainage, but this should not be a bar to doing so. Every experienced trackman knows of several methods for solving this problem, one or more of which can usually be applied at any given location with satisfactory results.

If the solution is beyond the resources of the local forces, it is a matter that should have received the attention of the supervisory officers long before this season of the year. If it has not, it is quite certain that they have been negligent.

Another matter that should not be overlooked is the condition of the stock rail. Owing to the heavy wheel loads of today, stock rails and switch points wear more rapidly than formerly, while the metal of the stock rail tends to flow and force the point away, thus creating a cause of derailment if neglected. For this reason it is desirable that every turnout be equipped with an unworn or little-worn stock rail before winter. At the same time, the condition of the switch stand and the throw of the points should be investigated to insure a tight fit of the points against the rail for both straight and turnout movements.

By reason of the heavier wheel loads, bolts and other fittings wear more rapidly on modern switches, despite their better construction as compared with that of only a few years ago. It is well, therefore, to observe the condition of all bolts and the fit of all switch accessories, making such corrections, including the replacement of cotter keys, and adjustments as may be necessary. Special attention should be given to frog and wing-rail bolts. The tension in springs should be tested and adjusted, and any inequalities in line, surface or gage should be corrected. Guard rails should be inspected for gage, flangeway, the fit of all parts, and to insure that they are properly secured. It is assumed that at this season, the switch ties are in a sound condition and will require no further attention until the following year.

ORGANIZATION

The Advent of Power Tools Wrought Great Changes

THE third decade of the twentieth century will be long remembered among maintenance of way men as the period during which the use of power equipment became thoroughly established. However, those ten years were marked by another development, which, although progressing concurrently, created far less notice, in spite of the fact that its effects are equally far reaching. The advent of mechanical appliances gave rise to an interest in the subject of gang organization that had no parallel in the earlier days of maintenance of way and that has exerted a profound influence on the economies now realized.

Until the introduction of machinery in track work, gang organization was left largely to foremen of demonstrated ability in handling men. It consisted, in the main, of the distribution of the work among men skilled in the various tasks, and the shifting of these men from one group to another as necessity arose to secure the necessary balance in the forward progress of the successive units of the gang.

This was relatively simple, as the man was the unit of production and in most operations, adding one man to, say, a group of ten, automatically stepped up production ten per cent. Furthermore, there were no maximum or minimum limitations on the size of the gang. Variation in the number of men, within reasonable limits, affected only the rate of progress; it had little influence on efficiency.

In mechanized operations, on the other hand, the production unit is the machine, not the man, and in such work as rail renewals, the number of production units for the various operations is relatively small. For example, there can be only one unit to handle the rail, two or three for the tie adzing, as many as four, perhaps, for power spike driving. Consequently, any change in the number of units employed produces a proportionately large change in the rate of production.

The use of power equipment has, therefore, imposed some perplexing problems. Each machine employed must work as near as possible to capacity, since otherwise neither the machine nor the men employed to serve it will earn what they cost. Therefore, unless the various operations are rather effectively balanced, some machines, although used to capacity, will lag behind and slow up the operation in the rear, thus preventing other machines from producing their full output. However, these considerations influence also the number of men to be employed in the manual operations, since the work that cannot be done by machinery must be completed at a rate that will keep up with the machine work. Thus, the number of machines employed and the size of the gang are closely inter-related.

From a practical standpoint, the fact that some operations are still necessarily performed manually affords one answer, since these men can be shifted from one operation to another to overcome lack of synchronized progress. The fact that there are wide variations in the makeup of gangs employed in the same operations with much the same equipment indicates that there is more than one solution to these problems. But the fact remains that experience with the application of power equipment to major renewal operations has made most maintenance officers "organization conscious," creating thereby a more critical attitude toward economy in the use of man power in all manner of operations. As long as this condition prevails, improvements in organization will continue to be made as they become evident.

INSULATION

Investment Pays Dividends from Savings

ALTHOUGH it is now too late to apply insulation to old buildings before winter arrives, this is a matter that should receive the serious attention of building officers in connection with future work. There are many structures in service that should be given a general overhauling next year, or in subsequent years as rapidly as they can be reached, in which no better investment can be made, or one that will return larger dividends than that necessary to insulate them thoroughly. Tests have shown that the cost of the application can be amortized within a few years from the savings that are obtained in the cost of heating, and that thereafter the full effect of the resulting economies is reflected in the operating accounts.

For some unexplained reason, despite the fact that fuel savings of from 20 to 40 per cent can be obtained through the use of insulation, the application of this material in railway buildings is far behind that in practically every other field of building construction. It is true that roof insulation has been installed in a relatively few instances, but this is only a partial step in the right direction, and it is believed that a more thorough acquaintance with the possibilities for economy through the use of insulation, of which there are many dependable types on the market, will insure its wider use.

While certain definite principles must be followed in applying insulation, proper methods of doing so are easy to learn. Once educated to these practices, any experienced carpenter can do the work, provided he gives the necessary attention to the essential details. For this reason, no special organization is required, but the application can be made as a routine matter in connection with other work.

Is Standardization Pra

[This article is the first of a series in which the facts will be presented concerning the numerous and wide diversity of designs for track materials and tools. The problems of manufacture which arise from these diverse requirements and the ways in which they affect the railways as a whole will be pointed out. The practicability of standardization and its probable effect will be discussed, and a solution for the problems inherent in the present situation will be offered. The present article will deal with the general features of standardization and the problems connected with it.—Editor.]

WHY should one road have 23 distinct designs for track bolts? Why is it necessary for a single manufacturer to maintain dies for 59 patterns of track wrenches? Is it within reason that there should be 144 different sizes and designs for so simple a tool as a lining bar? Can a satisfactory reason be advanced for the fact that there are already more than a dozen different drillings for the new 112-lb. and 131-lb. rail sections, which were adopted only a few months ago? Are the riding qualities of the track improved by reason of the more than 1,000 different designs of joint bars that are in service today? Is track construction made better or more economical by the more than 5,000 different designs and punchings of tie plates? These are pertinent questions which reflect only a few of the amazing facts arising out of the multiplicity of designs to be found in track materials and tools, and which have their counterpart in other fields of industry. Furthermore, if variations in specifications covering the materials and methods of manufacture were to be included, the foregoing figures would be even more startling in their revelations.

Present Practices of Ancient Origin

Is there a logical reason for this great diversity of designs, or does it reflect an attitude on the part of railway engineers for which little adequate reason can be assigned? The answer to this question is to be found, in part, in the fact that during the early days of the railways almost every phase of their development was characterized by the most decisive individualism. This is not surprising, since there were no precedents to follow and no previous experience to guide the men who were engaged in this development. In other words, they were perfecting a new art, and this could best be done by many men working toward the same objective, each seeking in his own way to solve the diverse problems that confronted him.

As a consequence of this individualism there were no standards as between roads, while in many cases different sections of individual roads were working to different standards. Yet, in time, there was a definite evolution toward certain types of designs as well as of practices. Rail provides an excellent illustration of this trend. Originally made of cast iron, then as straps fastened to longitudinal timbers, these forms became obsolete when Stevens designed the first T-rail section. Despite a multitude of later designs which varied widely from the T-section, this section persisted. Steel eventually superseded iron for rail manufacture and with it came still greater activity in the design of rail sections, practically all of which, however, were merely variations on the basic T-form. In other words, disregarding occasional sporadic attempts to break away from this type of section, and despite the many variations of design that have been, and still are, in use, the general trend has long been toward one basic type of rail section.

Standardization of Rail Sections

There was no thought, however, of standardizing rail sections. On the contrary, every chief engineer was trying to develop designs which he believed would most fully meet the conditions on his road. Later, as experience accumulated, certain facts began to point to the desirability of reducing the multiplicity of sections then in use. The first tangible effect of this realization that a reduction was desirable, was the development of the A.S.C.E. sections about 1893. These sections did not prove entirely satisfactory, but they did point the way toward simplification which resulted in the two types

How far can the railways be expected to go in eliminating the multiplicity of designs that prevail in many materials and tools today? Are rigid standards desirable? Will they be accepted generally? Can standards be developed that will meet the needs of roads as dissimilar in volume of earnings as the two illustrated here?

Practical?

of A.R.A. sections about 14 years later, and finally in the A.R.E.A. series of sections, with the result that at present rail design has been greatly simplified.

Gage provides one of the earliest examples of standardization. In the beginning there was a wide variety of gages, which ranged all the way from 3 ft. to 6 ft. The earliest roads were built expressly to accommodate trains of wagons. These vehicles, following the English practice, had a gage of 4 ft. 8½ in., and it was natural that the track gage should correspond. Engineers who located and built lines through the mountains favored narrower gages because they reduced construction time and costs. As new roads were built in the easier country of the prairies where no such limitations were encountered, the wider gages were more in favor.

As a result, a multiplicity of gages arose, creating numerous instances where cars of one road could not be operated over the rails of another with which it had one or more points in common and with which it exchanged both freight and passengers. As railway mileage was extended and traffic increased the necessity for interchanging cars between roads to eliminate the cost and loss of time involved in transferring cargos, resulted in the adoption of a single gage for all trunk-line roads. Likewise, as the interchange of cars became more common there was a gradual trend toward the standardization of certain features of their construction, such as couplers, to facilitate their handling on foreign lines as well as to facilitate their repair while on foreign rails.

On the other hand, no such influences confronted the construction and maintenance departments. The engineers in these departments were free to develop their designs, practically untrammeled by considerations beyond the limits of their own lines. The result was that in the design of the materials and tools necessary to the work of his department, every chief engineer was a law unto himself. He was free to change his designs as frequently as he thought desirable and, in numerous instances, a change in chief engineers resulted in a complete change in the standards of the road.

This review of early conditions has been given because the practices then developed and the viewpoint of the earlier generation of engineers have contributed in large measure to the diversity of designs prevailing today. It should not be taken for granted, however, that these conditions are peculiar to the railways. American industry at large has developed largely along the same highly individualistic lines and there are those who maintain that if this condition had not prevailed, there would not have been the unequalled progress which has made this country the foremost industrial nation in the world. In fact, individualism is still a characteristic of industry, despite the many agencies that are working for standardization. As an illustration, manufacturers are still making more than 15,000 different sizes and shapes of bolts for the industrial field alone. The automotive industry is often cited as an example of standardization carried to its ultimate possibilities. Yet, one need only attempt to remove a hub cap from an automobile to find how many wrenches are required for different makes of cars.

Progress Being Made

Individualism in design, which was so prominent a characteristic of the earlier days of railway development, has by no means been adandoned, although there has been a tendency in recent years to restrict designs to fewer types. Insofar as track materials are concerned, this movement was initiated originally by the Roadmasters' Association, and certain recommended designs for track tools were developed as long as 40 years ago, some of which are still standard on many roads today. This association also inaugurated the movement to reduce the number of rail sections, and it was at its request that the American Society of Civil Engineers undertook the study of rail design which resulted in the A.S.C.E. sections. Much other work of similar character was done by this association, which tended to reduce still further the wide range of designs so common 40 or more years ago.

Following the organization of the American Railway Engineering Association in 1900, the Roadmasters' Association relinquished to it matters relating to standardization of materials and other accessories. Through its committees, this newer association has studied many subjects and has from time to time recommended certain standards to the railways. As a result of the work of these two associations, as well as of individual roads, there has been a definite trend toward the standardization of many of the practices of the railways and of the materials that they use. Despite this trend, however, there is still an astonishing diversity in the design of practically all of the materials and tools employed in the construction and maintenance of track.

In view of this trend and of the work which has already been done by these associations and by individual roads, why cannot we now go to fairly complete standardization? This is the avowed objective of numerous students of the subject, some of whom contend that both materials and design should be brought to rigid standards and the use of these standards should be made obligatory. Others who have studied the subject equally thoroughly contend that it is of too much importance to be decided without a complete exploration of its possibilities and probable results. They present a number of questions that they believe should be given consideration before a decision is made. Is rigid standardization desirable? Will rigid standardization stimulate or retard progress? Will the railways accept rigid standards?

Those who advocate rigid standardization contend that, since many of the designs are only variations of basic types, there is no reason to believe that a satisfactory

mean cannot be found which will be equally applicable to all roads. In support of this view, they call attention to the fact that many of the diverse practices of former days have been partly or completely standardized.

Present Practices Entail Waste

One of the important arguments advanced by the advocates of rigid standardization is that it will reduce manufacturing costs. They point out that in the multitude of designs now in use, many differ only in non-essential details and that some of these differences are so slight that they are not easily discernible. They hold that these differences do not affect utility, but that they do add materially to manufacturing costs which, obviously, must ultimately be passed along to the railways.

This group emphasizes the waste that is entailed by the present multiplicity of designs, since for years railway-supply manufacturers have been forced to provide an equally wide variety of rolls, dies and patterns. They show that this has resulted in an excessive duplication of patterns, and has thus added to the cost of production, especially since many roads distribute their orders among several manufacturers, adding still further to the total cost of rolls, dies and patterns.

Another element of the present situation to which they direct attention is that, in general, these special designs reflect in large measure the individual ideas (or hobbies) of the engineers in charge on the individual roads, and may be changed at any time without notice. This, they say, makes it impracticable for any manufacturer to stock up such designs and prevents him from keeping his plant in production during dull periods to meet the demands of more active seasons. On the contrary, he must await specific orders before he can manufacture the articles desired by the road.

The men who advocate rigid standardization look upon the present conditions with respect to multiplicity of designs as little short of chaotic, and contend that they can be corrected only by their method. They recognize that objections will be raised to rigid standards, however, and some go so far as to say that pressure should be exerted on recalcitrants, if necessary, to bring about the universal adoption of such standards as may be developed. It is their belief that the economies resulting from a reduction in the number of rolls, dies, etc., and the opportunities that will be afforded to manufacturers to keep their plants on a uniform production basis will so reduce manufacturing costs as to permit a marked reduction in the prices of the articles used by the railways.

Two Groups Oppose Standardization

On the other hand, there are two groups which, although they admit frankly that the present multiplicity of designs is undesirable, do not accept the view of those who advocate rigid standardization. The first of these groups is opposed to any form of standardization. They believe that all or most of the problems inherent in the present situation will be solved in the natural course of events. In support of this belief they point out that a process of elimination has been going on for years. The other group, while admitting the force of some of the arguments advanced by the advocates of rigid standardization, believe that the conclusions of these advocates have been reached without consideration of all of the factors involved. In fact, they say that several important factors have been overlooked entirely.

They take the position that a standard is worthless unless it is accepted generally, and point out the difficulty of enforcing standards. They call attention to the fact that it has been the repeated experience of those engaged in standardization that, because of the wide range in the practices of the interests involved, practically all standards represent a compromise between the conflicting ideas that are presented.

These men contend that for these reasons rigid standards are generally unacceptable to most of the roads, since they represent too great an advance for one group of roads, while at the same time, they fail to come up to the existing practices on others. The natural result, which they say has been confirmed by experience, is that only a few adopt the standards as developed, and the others continue to use their existing individual designs or prepare new ones more in keeping with what they believe to be their requirements. They point out further that it cannot reasonably be expected that the more progressive roads will be willing to accept as standards compromise designs or specifications which represent an actual backward step in the practices they have developed, nor do they believe that such a step would be desirable. They also call attention to the fact that there are certain engineers who, while indifferent about what others do, are unwilling to accept designs that are not their own or to relinquish their independence of action with respect to evolving designs and specifications which they are convinced are better adapted for the conditions on their own roads. In further support of their contention that standards are difficult to enforce, they cite the fact that among the limited number of roads which have accepted the new A.R.E.A. rail sections, several have already demanded drillings different from that called for by the standard.

Another point which they stress is that both the physical and financial conditions of different roads vary within wide limits, and that even on individual roads the physical differences may be very great. They claim that for these reasons a single standard cannot possibly be made to meet all of the requirements of all of the

roads. In support of this they show that a heavy rail that may be a necessity on a road having a high density of traffic might be rank extravagance on some other road of light traffic. Likewise, they point out that the rail, joint bars, tie plates, etc., that are entirely suitable for the latter road could not possibly be used on the former.

Do Standards Retard Progress?

Those who oppose rigid standardization contend also that a standard, once adopted, whether completely rigid or somewhat flexible, tends to become a fixture, and that the longer it is continued in use the more firmly it becomes fixed. They maintain that this is not a theory, but that its truth has been demonstrated in numerous instances. In their view, therefore, one of the prime reasons why such standardization is objectionable is that it tends to bar further progress. They also contend that standardization tends to smother initiative, since there is little incentive to develop new ideas that conflict with established standards. It has been their observation that, where standards are in use, new ideas meet inertia, if not open opposition, on the ground that they will increase production costs and, therefore, prices, the very thing the standard was intended to avoid.

They also point out that much of the progress that has been made in both design and materials must be credited to manufacturers. They believe that if the incentive to continue these improvements is removed by rigid standardization, the progress that must be credited to this source will also come to a standstill. There are other considerations which they maintain, as a matter of justice, must be given weight. In this connection they point out that many of the devices in common use are protected by patents, the value of which will be destroyed by rigid standardization. Furthermore, since it is obvious that in developing standards they must be designed to avoid patent infringements, they contend that this factor alone is sufficient to insure inefficiency in the design of some of the standards that may be developed.

Has Railway Development Reached Its Climax?

It is their further contention that railway development has by no means reached the stage of crystallization, but that it is still in a state of flux. They hold, in fact, that changes in engineering practices, operating methods, materials and equipment, in short, in the railway field as a whole, are going on at a more rapid rate today than ever before; that railway officers are more actively engaged in developing new, better, and more economical methods than at any other time in the history of the industry. They believe, therefore that it would be a serious error to impose any form of standardization, and particularly the rigid type, at this time, since this would tend to smother these developments and handicap the roads in meeting the competition to which they are being subject to an increasing degree today.

What then does this group propose? Is it content to allow the present largely unrestricted individualism, with its multiplicity of designs and specifications, to continue? Or does it have some constructive alternate proposal? In answer to these questions, the response is that the present situation is recognized as undesirable from the viewpoint of the railways and the manufacturers alike. Its spokesmen point out, however, that every investigation that has been made in fields where a multiplicity of designs prevails, has disclosed that the bulk of production is confined to a relatively few designs. They cite as illustration the fact that when the Division of Simplified Practice of the Department of Commerce began its study of the grinding-wheel industry, it found that although more than 700,000 different sizes and shapes of grinding wheels were being manufactured currently, considerably more than half of the total production was confined to about 10,000 items. Again, it found that while as simple a product as paving brick was being made in 66 different sizes and shapes, it has been possible to reduce this number to 5 sizes without inconvenience to users. As a further illustration, they point to solid-section steel windows, approximately 43,000 different designs of which were on the market, yet five per cent of these accounted for the bulk of the production. Likewise, in the case of hacksaw blades, 160 different sizes and designs were reduced to 38 without imposing any hardship on the various industries in which they are used.

Bulk of Production Confined to Few Designs

It is their further contention that a similar, but less extreme, situation exists with respect to railway supplies. In other words, they maintain that investigation will show that more than half of the production of practically every unit of material used in this field is confined to a few designs and specifications and that the remainder represents a relatively small part of the total production that can be abandoned without serious difficulty. To this extent they take the same position that is taken by the advocates of standardization, namely, that where the differences in design are inconsequential and do not affect utility there is no sound reason why these differences cannot be composed. They assert that by making a reduction in the number of designs and material require-

ments in this way, all of the benefits of standardization will be obtained without what they consider its undesirable features. In fact, they do not hesitate to say that so far as some materials are concerned, the economy of rigid standardization is greatly exaggerated.

How Far to Go?

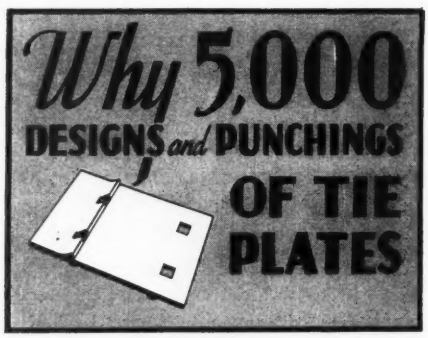
Those who advocate some reduction in the number of designs face, however, the question of how far this reduction should go. Can it be stopped short of rigidity, that is, a single design for each item? Or can it be so managed as to provide a certain amount of flexibility and provide an opportunity for choice between two or more alternate designs? Those who favor complete standardization believe that it will be so difficult to stop short of complete rigidity as to be impracticable.

Those who take the opposite view cite the experience of the Track committee of the A.R.E.A. in its work of standardizing switch, frog and crossing construction. During the 20 years that this work has been under way, literally hundreds of conflicting ideas have been presented, sifted and compromised, to produce the present stand-

ards. Yet, despite the long period during which these standards have been undergoing evolution, the committee has found it expedient to provide alternate designs, so that different roads can choose from these designs those that more fully conform to the conditions they are required to meet than would be possible if the standard had been made rigid. In other words, they contend that this flexibility was necessary to obtain acceptance of the standards. They also point out that while only a small percentage of the switches, frogs and crossing that are being manufactured today conform to these standards in all respects, and that some of them differ in important respects, the net result is a very general compliance with the standards, all details considered.

What Should Be Done about It?

In giving consideration to the situation revealed by the questions asked in the beginning, which are based on actual records; to the practices which the present generation of railway engineers have inherited; and to the trends of thought of those who believe that present conditions with respect to design and material specifications require correction, certain other questions arise. What *is* the present trend with respect to the design of tools and materials used in track construction and maintenance? Toward what objective should railway engineers direct their efforts? Should the unrestrained individualism of the present, with its multiplicity of designs, be continued? Should they work toward rigid standardization? Or should they aim only at a reduction of the many designs now in common use? If standardization is desirable, how far should it go and should the adoption of standards be made mandatory? These are not idle questions, but indicate problems in which a number of important



agencies are at present taking an active interest. The American Railway Engineering Association; the American Railway Asociation; the Federal Co-ordinator of Transportation, through the Section of Purchases; and the National Recovery Administration, indirectly through various code groups, all have these matters under consideration at the present time.

No Common Ground So Far

The attitudes of both the proponents and opponents of standardization have been presented. It is clear that, so far, they have found no common ground, although they agree on a few points. This being so, it seems natural to inquire whether some alternate proposal, or middle ground, can be found which will be superior to either unrestrained individualism or rigid standardization. The questions that have been asked are too important to ignore; they should be met with an open mind and decided only after all of the facts are known and have been given thoughtful consideration.

In the belief that these matters and the proper solution of the problems connected with them are of real importance to the railways, and in the further belief that a knowledge of all phases of the situation is necessary for their solution, *Railway Engineering and Maintenance* has undertaken an extensive investigation of the subject, insofar as it relates to the materials and equipment used by the engineering and maintenance of way department, for the purpose of presenting to its readers the facts that exist, what it finds to be the present trend and, finally, what it believes to be the best solution of the problems that have arisen as a result of past and present practices.

Purpose of Series

Those materials and devices which are most definitely before the railways at present include track materials and tools. For this reason, it is to them that we have first directed our attention. The results will appear in a series of articles in which there will be discussed separately rail, joint bars, tie plates, bolts and spikes; and individual track tools or groups of tools, including lining, claw and tamping bars; wrenches; spike mauls, sledges and chisels, tamping and clay picks; adzes; and shovels. These articles will portray the present multiplicity of designs and specifications, will point out the problems that manufacturers face as a result of these diverse requirements and will show how the present practices react to effect the welfare of the railways.

Unfinished Road Crossing Causes Derailment

NEGLECT in the proper maintenance of a highway crossing which had been left in an unfinished condition following renewal, permitting the accumulation of crossing material on the rails, resulted in the derailment of a passenger train on the Chesapeake & Ohio on July 7, 1934, near Paintsville, Ky., according to a report on the accident by the Bureau of Safety of the Interstate Commerce Commission. The following facts concerning the accident, which resulted in the death of the fireman and the injury of the engineman, are abstracted from the report.

The derailment occurred at a highway crossing situated on a 4 deg. curve on a double-track line. The track in the vicinity of the crossing had been raised about 4 in. prior to the accident, necessitating the removal of the original crossing. Following this work, the spaces between the rails and the tracks at the crossing were filled with ballast, which was covered with about 2 in. of limestone chips, the top of this material being about level with the top of the rails. The intention was to apply a binder to this material on June 27, but at that time the binder that had been obtained for the purpose was found unfit for use. The crossing was still in an unfinished condition at the time of the derailment.

The highway crosses the tracks at an angle and on the outside of the curve makes a sharp turn at the ends of the ties, thereafter paralleling the tracks for a short distance. The ballast and crossing material at the point of the sharp turn in the highway were found to have been disturbed by the wheels of automobiles to such an extent that a quantity of the material was deposited on the high rail of the outside track, thereby causing the derailment. In conclusion, the report stated that "the section foreman should have taken steps to insure that the crossing was maintained in such condition that trains could pass over it safely."

Where Do We Stand?

What is the present condition of our tracks, after four years of retrenchment following seven years of intensive betterment? What does the future hold out for us? An analysis of these problems by one of the leading authorities on track maintenance

By EARL STIMSON

Chief Engineer Maintenance, Baltimore & Ohio, Baltimore, Md.

Earl Stimson

ROADWAY requirements are measured by the amount and the kind of use made of the roadway—the density of traffic, the weight of equipment, and the speed of trains. The high point in the use of the roadway on American railroads, as indicated by the revenue ton-miles produced, was reached during the years 1926 to 1929, inclusive. The average for these four years was 438,180,048,749 revenue ton-miles, with a maximum of 447,321,561,129 in 1929. During these four years expenditures for maintenance of way also reached a high point, with an average of $857,165,353 and a maximum of $868,581,432 in 1927.

Who would have thought that the traffic handled over the railroads would suddenly shrink to the low level of 233,977,008,859 revenue ton-miles in 1932, and that the roadways would be maintained with an expenditure of $322,286,218 in 1933? This represents a decrease of 48 per cent in revenue ton-miles and 63 per cent in maintenance of way expenditures from the averages mentioned.

Preparation for the Famine

It was fortunate that during the years of plenty we were, although quite unaware, preparing for the years of famine that were to come. During the seven years just preceding the break late in 1929, with the exception of 1924, when the mark was missed by only a small margin, more than $800,000,000 was spent each year on maintenance of way. Large tonnages of heavy rails were laid, roadbeds were widened and drainage improved, large

*An address presented before the convention of the Roadmasters' and Maintenance of Way Association at Chicago, on September 18-20.

mileages of line were ballasted with stone and gravel, the use of treated ties became almost universal, improved methods of surfacing were adopted, improvements were made in rail fastenings and track appliances, bridges were renewed in permanent form—all of which went to make up the stiffer, stronger and more permanent roadway that was required for the heavy traffic that prevailed during those years. The result was that at the end of 1929, the railroads of this country had been built up to a high standard of maintenance, which has made possible their maintenance to an adequate standard with remarkably low expenditures during the ensuing four years of curtailed traffic and earnings. During this latter period, maintenance has not benefited from capital expenditures, as these have fallen from an average of $631,562,000 for the past 10 years, to $103,947,000 in 1933.

Present-day roadway requirements call for less of the material and more of the spiritual, if such a term can be applied to the ability to carry on and to direct and inspire men to their best efforts under adverse conditions. It requires courage, leadership, initiative, resourcefulness, judgment and confidence. The fact that the maintenance of way department has met the test so successfully during these trying years is ample evidence that the roadmasters possess these qualities.

Speeds Have Increased

While the volume of traffic has greatly decreased and has thus lessened the wear and tear on the roadway structure, the average wheel-loads have increased through the retirement of much of the older and lighter equipment. Moreover, there is a tendency toward higher speeds for both freight and passenger trains to meet the competition of motor vehicles and airplanes. To provide for these

new conditions, the same strength and stiffness of track structure are required as was found necessary to carry the greater volume of traffic of former years. In fact, to meet the demands of the increasing speeds, much is being done to strengthen and stiffen the track to provide a smooth running surface with less maintenance expense.

Perhaps the most important step in this direction has been the adoption of the new rail sections that went into use this year—the 131-lb. section superseding the 130-lb. section and the 112-lb. section taking the place of the 110-lb. section, and on some roads the 100-lb. section. These new sections add stiffness to the track, but their big advantage is the increase in the depth of the joint bars, giving increased strength where it is most needed. If we could develop a joint that would be as strong as the full unbroken section of the rail, or if joints could be eliminated entirely, the problem of track maintenance would be simple. The constant study that is being given the rail-joint problem and the progressive improvement that is being made in design and manufacture certainly will result ultimately in something approaching the ideal.

Better Designs for Joint Bars

We started with a pair of flat plates to splice the rail ends at the joint. These were called "fish-plates" or splice-bars and offered little vertical support. Later the "angle bar" was developed, the vertical flange being formed at the top and bottom to provide a wedge fit with the underside of the head and the top of the base. The horizontal flange was extended outward from the base of the vertical flange to beyond the base of the rail, and was slotted for spikes. This added lateral stiffness to the bar and provided a spiking-toe to spike the joint bars to the ties to keep the rail from running. This, however, resulted in the slewing of the joint ties, although with the advent of the rail anchor any excuse for slot-spiking the angle bars vanished. Furthermore, mathematical study of the angle bar disclosed that much of the metal in the lower flange was ineffective in supporting the load.

In connection with the work of the A.R.E.A. Committee on Stresses in Railroad Track, under the direction of Dr. A. N. Talbot, an exhaustive investigation of joint bars was made, and Dr. Talbot's "G" section resulted. This section is of the toeless type, with the properties of the head and base well balanced. It gives the maximum strength for the weight of metal provided within the limitations of the fishing space. This design gives a high percentage of strength as compared to the full rail section and, with some modification, is now in extensive use, especially with the new 131-lb. and 112-lb. sections. It is anticipated that it will give excellent results.

It must be borne in mind that good results are dependent upon as nearly perfect a fit as possible between the joint bar and the rail and the maintaining of the proper bolt tension. Without these the best joint bar ranks no higher than a poor one.

Eliminating Joints

I spoke of eliminating rail joints entirely. This has been done by welding the rails together at the ends in locations where they are protected from the sun, as in paved streets and in tunnels where the range of temperature changes is limited. For tracks where the entire rail is exposed to the sun, this method has not been found practical. In some European countries rails of a length of 30 meters (approximately 100 ft.) are in service and satisfactory results are reported. In this country small amounts of 60-ft. and 66-ft. rail have been laid for experiment. Long rail are obtainable in small quantities only and at additional cost, as the mills are not laid out to produce rail of more than standard length without extra handling. One eastern railroad is making a bold experiment with two sections of track of about one-half mile each, laid with rails welded together, thus forming in effect a continuous rail. These experiments will be watched with interest, as the results will undoubtedly have an influence on future practices.

The length of cars available for loading the rail at the mills has been the determining factor in fixing the standard length of rail. As the prevailing length of the cars increased, so the length of rails increased—from 30-ft. to 33-ft., then in 1925 from 33-ft. to 39-ft. which is the present standard. Car lengths have now increased sufficiently to permit a rail length of 45-ft., which is perhaps the maximum for convenient and economic handling. To go beyond that length will put the manufacturers to heavy expense for alterations of the mills. The increase of the rail length to 45 ft. will reduce the number of joints 13 per cent and effect a like reduction in labor for maintaining and surfacing joints.

Better Tie Plates

With the use of treated ties, the importance of the tie plate has been emphasized. The first tie plates were small, little if any larger in area than the bearing area of the rail itself on the tie. The original purpose evidently was to assist in holding the gage on curves. To realize the full life expectancy of the treated tie, it is necessary to protect it against mechanical wear. The tie plate protects the tie from being cut by the rail and from damage due to regaging, which are the main causes of mechanical wear. As treated ties have a possible life of 30 years or more, this matter of protecting the tie has been given careful consideration. It is a poor place to economize. Best current practice points to a large heavy double-shoulder plate of sufficient bearing area to distribute the load on the ties in such a manner as not to crush the wood. The plate should have a flat bottom to insure uniform bearing and should rest on a carefully adzed bearing surface on the tie. The plate should be held firmly to the tie by lag-screws or spikes. A slight bevel on the plate that cants the rail inward about 1 in 40, is desirable.

The value of rail anchors is too obvious to warrant comment. If enough are used to the rail length, rail creeping can be prevented. The number required may be determined by experience, but four to six to the rail will generally suffice.

Water is the most persistent enemy to roadway maintenance and one against which we wage constant battle. To keep down surfacing and lining costs, which consist entirely of labor, requires a dry, firm roadbed, which can be obtained only through the intelligent application of the well-known drainage methods.

The prevailing high speeds of both passenger and freight trains call for refinements in the line and surface of track which require uniformity of rail support. Machine tamping has been found to contribute best to this uniformity of support, as firmer and more uniform tamping of each tie can be secured with machines than by hand. However, even with machines it takes skillful handling by the men and close supervision on the part of the foreman to obtain truly uniform results. The mechanical tamper was one of the first machines adapted to maintenance of way work. Its use has been more than justified by the economies it has effected, thus paving the way for the procession of maintenance of way machines that have followed.

The up-to-date maintenance of way man is now thoroughly machine-minded and fully alive to the advantages and economies accruing through the use of machines. What sight is more inspiring than a fully mechanized rail gang, well organized and balanced so that each operation, with its machine, keeps pace, from the spike-pulling machine in the lead to the power spike drivers and wrenches in the rear.

Under the pressure of circumstances, the maintenance man has been thrown on his own resources during the past four years. He has had to get along by fixing up what he had, instead of replacing it with new material. An outstanding example of this is the reconditioning of worn and battered rail and worn frogs, switches and railroad crossings by the welding processes. The reforming of worn joint bars is another example of reconditioning that is done extensively. By such methods the life of the material has been extended, so that the purchase of new material has been deferred. As these are major items of maintenance expense, large savings have been made.

On the Baltimore & Ohio we have a yard stick for measuring results that applies to other railroads as well. This measure is based on a figure defined as the gross ton-miles per man-hour worked. In 1929 the B. & O. carried 1,492 gross ton-miles per man-hour worked. In 1933 there were 2,454 gross ton-miles per man-hour worked, an increase of 65 per cent.

Full advantage has been taken of treated ties and a number of roads that have a large percentage of treated ties in track have been able to hold their yearly renewals below an average of 100 per mile for the last five years. The investment in treated ties is bringing full returns.

The Value of Research

One of the most important steps taken to meet present day requirements is the employment of research to solve the technical difficulties encountered, as well as to search for new and better things. About as fine a piece of research work as has been undertaken by the railroads is that on Stresses in Railroad Track, carried on under the direction of Dr. A. N. Talbot and sponsored by the American Railway Engineering Association. Another outstanding example is the Transverse Fissure Investigation now being conducted by the Engineering Experiment Station of the University of Illinois, under the direction of Professor H. F. Moore. This work is sponsored jointly by the Rail Manufacturers' Technical committee and the American Railway Association.

The rail manufacturers have done much in the way of research and experimenting to improve rail steel and the manufacturing processes. Sufficient quantities of rail that have been heat-treated, or subjected to controlled cooling, normalizing, or the hardening of ends, have been put in track for comparative test, and the results are awaited with great interest. It is expected that a better wearing rail and one less susceptible to transverse fissure failures will result.

In the foregoing I have tried to give you a picture of the present-day situation. No one can tell what the future will develop. There are indications that the limits of weights of equipment have been reached. The "Zephyrs," with their Diesel electric motors and all-aluminum cars and the experiments with light-weight freight cars, also built of aluminum or high-tensil, rust-resisting steel, at least point in that direction. With a reduction in wheel loads, there will be no need for a further increase in the weight of rail or any necessity for further strengthening the track. It is within the range of possibility that we may ultimately revert to correspondingly lighter rail sections.

Our present problem, and for some time to come, is one of economy. The days of a maintenance of way ratio of 12 or 14 per cent of the gross earnings are past. In the future 10 per cent will be demanded.

Derailment Caused by Sand Deposit after Overflow

SAND and gravel deposited on the track by an overflow of water resulting from a heavy local rainstorm of short duration caused the derailment of a passenger train on the Denver & Rio Grande Western on July 26, 1934, near Echo, Colo. The accident resulted in the death of a trespasser and the injury of 34 passengers and 7 employees. The following account of the circumstances surrounding the derailment was abstracted from a report submitted to the Interstate Commerce Commission by its Bureau of Safety.

The derailment occurred on a 6-deg. curve at a point where the railroad parallels the Arkansas river in the Royal Gorge, the single-track line being situated in a cut in the side of the gorge. As this is in mountainous territory, the rocky sides of the gorge are cut by deep gulches which carry large quantities of water during rainstorms. The derailment occurred near the mouth of a gulch which extends upward above the track to a height of 1,000 ft., the granite walls of the gulch being relatively smooth with no vegetation or loose rock to impede the flow of water. About 200 ft. above the track the gulch spreads out so that any water that it may be carrying ordinarily reaches the track at a number of points, being carried in a ditch along the track about 150 ft. to a 48-in. concrete pipe under the roadbed through which it empties into the river.

On the day of the accident the flow of water down this gulch was so great that it overflowed the track, depositing large quantities of sand and gravel on the rails. This deposit was 96 ft. long and a maximum of 3 ft. deep over the rails. As the face of the cut in this vicinity is on the inside of the curve, the vision of the engineman and fireman was obstructed so that they did not see the deposit in sufficient time to stop the train.

An interesting fact concerning this derailment was that the extent and duration of the storm that caused it was so limited that none of the railroad's employees was aware that it had occurred. At a station 4.2 miles from the point of the accident a very light rain, barely sufficient to wet the ground, fell on the day of the derailment, while the crew of a train that passed over this territory about two hours prior to the accident saw no water and no indications of an approaching storm. The section foreman, however, did notice a dark cloud in the vicinity and started to investigate, but was delayed by a rock slide on a branch line on which he was working. No trouble of this nature had been encountered at this particular point previously.

On the Louisville & Nashville at Bowling Green, Ky.

The Old-Time Section Gang

Our Maintenance Must They Be

By A. N. REECE
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Changing methods and practices affecting the track structure and the need for greater economy and efficiency in the conduct of maintenance work are among the problems facing the maintenance officer today. Mr. Reece, as revealed in this article, feels that specialized gangs, fully mechanized and manned by well trained men, hold the key to reductions in maintenance costs.

A. N. Reece

DEVELOPMENTS that have taken place during the last 20 years have made necessary a rearrangement of our maintenance forces. Although the number of man-hours of railway maintenance labor employed did not vary greatly following the World War until the latter part of 1929, the efficiency, or output, of this labor was greatly increased. This increase was obviously required in order to maintain the high wages, which were increased more than 100 per cent with our entrance into the war, and in order to take care of the increasing traffic and the higher speeds and heavier axle loads which were made necessary by competition with other forms of transportation. It was effected in three general ways. Large capital investments were made for drainage improvement, additional ballast, treated ties, heavier rail, and other improvements to the track and roadway to the end that less maintenance work would be required. Labor-saving equipment was developed to do maintenance work with less labor and therefore more economically, and also to produce a more uniform and durable quality of work. In order to increase this efficiency, attention was given to the training of workmen for specific tasks.

As a result, at the beginning of the depression, we had a railway industrial plant capable of handling twice the volume of traffic moved in 1914, with approximately the same amount of maintenance labor, but receiving more than twice as much in wages. When traffic eventually dropped to about 50 per cent of the former volume, there was a proportionate reduction in the work required of maintenance forces. Simultaneously there occurred a rapid growth of competitive transportation agencies, employing distress labor obtainable at low rates and long hours, and enjoying direct or indirect subsidies.

Change in Organization Necessary

As maintenance men, we owe our companies and our nation the duty of exerting all our energies in an effort to maintain our respective railways in a favorable competitive condition in relation to each other and to other forms of transportation. As these properties are a vital asset to our national service, economic position and defense, we must not let them deteriorate. To meet this challenge, some change in the plan of organization of our maintenance forces is made necessary by those developments which I have reviewed.

On most roads in the United States, the earliest form of maintenance organization consisted of section gangs supervised by section foremen. The large number of men required made this an efficient method. In addition, it had several other important advantages. The section foreman was held responsible for the condition of his track. Workmen were close at hand in case of emergency. Program work, such as crosstie renewals, ditching, right-of-way cutting, etc., was carried out over the entire line simultaneously. The men had homes and families and lived at home, which was conducive to their happiness and good citizenship. They provided a personal contact with the public, which prevented the company from being considered just a big corporation with no interest in individuals. The supervisory force consisted of track supervisors, or roadmasters, each of whom directed the efforts of a number of foremen, arranged for the necessary material, studied their problems, instructed them in the proper methods of work, and in general was responsible for the efficient utilization of labor and material.

I am reluctant to abandon this form of organization. However, we must recognize that the financial emergency now confronting the railways demands that every possible effort be exerted to increase the efficiency of the maintenance organization. In accomplishing this purpose we have before us a promising opportunity to re-plan our organization by making a more extensive use of the many excellent types of labor-saving equipment that have been developed in recent years. The most advantageous use of this equipment will require the formation of specialized gangs for its operation and a further benefit in economy will be obtained through this specialization of labor.

Labor-saving equipment has been developed for almost every type of maintenance work. For trackwork, we have motor cars, ditchers, weed mowers and burners, ballast cleaners, tie tampers, tie spacers, tie adzers, spike pullers and drivers, rail-laying cranes, bolt tighteners,

*An address presented before the convention of the Roadmasters' and Maintenance of Way Association at Chicago on September 18.

Departments— Reorganized?*

and bonding machines. For increasing the life of track materials, we have gas and electric welding equipment for reconditioning rail ends, electric welding equipment for building up manganese trackwork, equipment for reconditioning worn joint bars, and rail and curve oilers. For bridge and building work we have power saws, power drills and augers, sand blasting and chipping devices, and paint spraying equipment.

New Forms of Organization

Railway maintenance officers are giving consideration to possible changes in the maintenance organization, most of which are aimed at a fuller utilization of specialized gangs. Many different plans are being experimented with which offer very encouraging prospects. One railway has practically eliminated section gangs, doing all its work with specialized gangs. Another has developed large and completely mechanized gangs for specialized work, but has continued section forces for the usual section work. Another has gone quite extensively into the use of patrol cars for directing emergency work, handling routine work which can be planned ahead by specialized gangs. These experiments must be continued. It is a field which offers much opportunity and which should be thoroughly explored. The results should be carefully followed and studied so that eventually a plan of organization best suited to the developments that I have reviewed will be produced.

When this plan is finally determined we shall find the systematic renewal of materials and all program work being carried out by specialized gangs equipped with power machinery, and organized and trained to secure from it the maximum efficiency. However, there will still be an important place for the section gangs in taking care of emergency work which, as we all know, is no respector of time, place or person.

Men Must Be Selected Carefully

In the rebuilding of our organizations we must give careful consideration to the most effective selection of men for the various duties. At this time, while we have remaining in our service the pick of our former forces and, in addition, a large number of furloughed men of equal or nearly equal ability, it is of utmost importance that we retain the good men and add those good men that are furloughed as the opportunity presents itself in the revamping of our organization. As the need for specialized workers materializes, we will discover opportunities for making use of men who are already familiar with our requirements, standards, safety rules and operating practices.

Extravagant claims and promises will often be made by men outside of the organization regarding their ability to fill vacated positions or new positions created by the acquisition of new equipment. In general, I am convinced that we have the best material available in our ranks for filling those positions. However, we must provide the necessary supervision and training for developing in these men the capacity for filling the new positions. When power equipment and special machinery have been acquired, our practice has been to recruit and train the gang for its operation from our own forces, which is a practice that I recommend strongly.

A System Welding Gang

A Bolt-Tightening Gang

A Ballast-Cleaning Gang

However, even under present conditions, it may be necessary occasionally to bring new men, especially track men, into the organization. It is hardly necessary to mention the importance of securing promising men for what might be termed raw material. New men should be selected with the thought that they will continue in the organization, to be trained as skillful trackmen and to be advanced to the position of foreman or supervisor or into the specialized work as opportunity offers. Men who are capable of assuming new responsibilities or of fitting themselves into the specialized gangs as occasion demands, represent a valuable asset to the company.

Roadmasters, therefore, should instruct their foremen thoroughly in the selection of new men. Such men should be strong physically, alert mentally, and industrious. They should be selected from the higher grade of man power available in the communities. A high school education is particularly desirable. They should be young men so they will have several years available for thorough training and later service.

Much of the success of the new organization will depend upon the selection of the proper foremen. The section foremen should be promoted from the section forces, in order to provide the trackmen with an incentive that

will contribute much to their own happiness and to the welfare of the organization. Foremen should co-operate in this respect by training their men as prospective foremen. The supervisory officers should encourage the interest of the foremen in this practice by complimenting them on their training of trackmen who, following their promotion to foremen, have demonstrated that they were well trained. By this means the roadmasters will always have a good supply of able men with whom to fill vacancies in the ranks of foremen or to fit in with specialized gangs.

As a rule, it is our practice to select the roadmasters from among those section foremen who have the necessary qualifications, although a few of the roadmasters' positions are used to train engineers for the positions of assistant engineer and division engineer. Generally, however, we favor filling vacancies among roadmasters with foremen who have shown themselves to be exceptionally capable men. And by capable men we mean a great deal. We mean men who have profited by their experience in track work, who are capable of handling men to advantage, who will inspire respect and loyalty among their men, who will plan work efficiently, who will co-operate with the organizations, and who will bear themselves in their relations with the public in a manner worthy of representatives of the company.

Functions of the Associations

Of equal importance with the selecting of members for the organization is the provision made for their future training. We should never consider that the organization is trained to that point of perfection where no further progress can be made. The training consists of education, supervision and discipline. It extends through the entire organization. The Roadmasters' Association is a means which you roadmasters have selected to keep yourselves informed concerning progress in maintenance methods and to work out the solutions of your problems together.

While on the subject of education, we might well discuss briefly those organizations that have the education of their members as their goal. By compiling the experience of its members into reports, the Roadmasters Association affords each member the benefit of experiences that no one man could hope to undergo in the normal span of life. Further, the association of men with a common interest is a pleasure to all concerned and it is certain that each member looks forward to the meetings with keen anticipation. The American Railway Engineering Association, as its name implies, is an association of railway engineers having as its purpose the solving of the many problems pertaining to the economical location, construction, maintenance and operation of railways, and it is the policy of our company to encourage its engineering officers to take active part in the affairs of that organization.

There are a number of other associations in which the supervisory forces of the maintenance department may continue their training. Some of these are: The American Railway Bridge and Building Association; the American Wood-Preservers' Association; the American Society of Civil Engineers; the American Society of Mechanical Engineers; the American Society for Testing Materials, etc. The current railway magazines also offer an opportunity for keeping abreast of the times, of which the fullest advantage should be taken. The "What's the Answer?" department of *Railway Engineering and Maintenance* should be actively participated in by all members of the supervisory force. Publications and literature should be passed along by supervisors to the foremen and trackmen and particularly to the specialized forces.

The supervisory forces should participate actively in this educational program, not only adding to their own education, but also passing the knowledge acquired along so it will produce the best results. We have organized an association of the section foremen and supervisory forces on our line, called the Kansas City Southern Maintenance of Way Association, which has proved of great benefit in educating our maintenance forces. Unfortunately, it has been necessary to postpone the meetings of this association for some time, but we have had one recent meeting and we hope to continue them in the future. At these meetings, papers are presented on subjects of current interest, each paper being followed by a discussion of the subject by those present. It is particularly important that these meetings be presided over by an interested supervisor who will encourage the men to discuss subjects and interchange ideas and who will, to a certain extent, direct such conclusions as he may deem desirable by virtue of his more mature experience and judgment. We believe the close contact between the men at these meetings and the consequent interchange of ideas have greatly increased the efficiency of the organization and the interest of the men in their work.

Discipline must be considered in the training of the organization. However, I have always believed that it is better to keep discipline as much in the background as possible by keeping the men interested in their work and concerned with maintenance problems so that disciplinary measures are necessary only infrequently.

Spirit of the Organization

Probably more important than the plan or the personnel is the spirit of the organization. The spirit is that part of our organization that enables it to replace a bridge, which has been carried away by a flood, in one day when it could not possibly be done in less than two. It is that part which enables it to battle with snow for two days without sleep or rest to keep the trains going through. It is that part which enables us to come through times of depression such as the present, keeping the trains on the track with only one-half the men that we thought were necessary four years ago.

The roadmasters and supervisors are the driving force and nerve energy back of the maintenance organization. It is impossible for them to visit each of their gangs each day. They must depend largely on the foremen to direct the different units of work, whether specialized gangs or regular section gangs. The training of the foremen in charge of these gangs and the manner in which the roadmaster or supervisor has developed the spirit of the forces will be reflected in the results obtained. Roadmasters and supervisors should not lose sight of the fact they are the backbone of the maintenance organization. It is through them that enthusiasm is engendered in the men and if this is done, the results will be gratifying both to the supervisor and to the foremen. There is no greater pleasure than the satisfaction of a job well done.

Let me urge you to take the personal interests of your men to heart. With your broader experience, assist them in their troubles. Your interest in them will increase the enjoyment that you derive from your position and create a feeling of loyalty in the organization which is necessary in order to secure the fullest co-operation. Happiness and contentment is a state of mind and not a state of conditions. Let us carry on, through the periods of prosperity with their blessings, and the periods of depression with their hardships, with an enthusiasm and interest in our work which cannot but result ultimately in improving the welfare of us all.

Only Ties With Less Than Two Years' Life Come Out In Connection With Full Ballasting or Reballasting Operations on the Erie

Being the principal item in maintenance costs, tie renewals are commanding a great deal of attention these days. As outlined in this article, Mr. Schram feels that only through modern treatment, field inspection and some digging in can the greatest economies be effected.

Tie Renewals Demand Most Careful Attention*

By I. H. SCHRAM
Engineer Maintenance of Way, Eastern District, Erie

TIES are the most perishable part of our track structure and their renewal comprises the principal item in our maintenance costs. At one time the cost of renewing ties was about twice that of rail and although the treatment of ties has altered this somewhat, it still remains one of the principal problems of maintenance forces.

Since our modern track took form, the size and functions of ties have remained almost unaltered; in fact, much of our track was laid originally with ties of present dimensions. The only change is preservative treatment, which is now practically universal.

Test records of treated ties indicate an average life of more than 20 years, and ties purchased and treated in accordance with modern specifications should greatly exceed this when protected properly against mechanical wear. A life of 30 years for such ties is anticipated. This means an annual renewal of only about 100 ties per mile, as contrasted with the old figure of 300 or more per mile.

This situation will undoubtedly become even more favorable in the future because tie quality is being improved continually. For example, the 1926 tie specifications of the American Railway Engineering Association were strengthened at the last convention in two principal ways. In dimensions, they now provide that the lengths, thicknesses and widths specified are minima for the standard sizes and that ties one inch longer, thicker or wider than the standard will be rejected. This eliminates the one-inch shorter and one-quarter inch thinner and narrower specification. The old specification, which permitted ties not more than two inches thicker and not more than three inches wider to be accepted by being degraded one size, has also been eliminated, and the size of the split acceptable has been reduced from 10 in. to 5 in., with the same provision for anti-splitting devices.

These changes should help greatly. The change with regard to oversize ties will be most acceptable to trackmen as they have experienced the difficulty and disadvantages of spoiling tie spacing and the proper ballast support by applying over-size ties. The A.R.E.A. Committee on Ties reports that a great improvement had occurred in compliance with specification. While market conditions undoubtedly influenced this greatly, the tendency will, it is thought, continue, as the value of such compliance becomes more appreciated.

Careful Inspection for Renewals Necessary

In spite of the progress that has been made, it is important that all of our methods of handling ties, such as digging in, of foremen controlling the number applied, and of desultory unloading at station sidings, be questioned and analyzed. No part of a tie renewal program is more important than that of determining the number of renewals to be made.

The purchase of ties now has to be planned far in advance of actual need, since sufficient time must be given to allow the ties to season before treatment. This seasoning period is as great as a year for some species of timber, to which must be added the time necessary for cutting, handling and distribution if the ties are to be bought directly in the field, as most roads now prefer in order that they can control quality. It is, therefore, necessary that the estimating of requirements be done carefully in advance, and this can be done only with an exact knowledge of the conditions prevailing on the line.

It is generally admitted that estimates for tie purchases must be distinct from actual inspection and that the replacements themselves should be based on inspection on the ground. Such inspection has been made for many years on most roads, but in recent years many changes have been made. It is no longer the general practice for

*From a paper presented before the Metropolitan Track Supervisors' Club in New York.

the section foreman to make his own inspection, but rather for the supervisor or roadmaster, accompanied by the foreman, to make it, and for their determination to be checked later by the division engineer or some other officer. It is generally found that less ties are marked than were first estimated, which shows the desirability of a field check.

It is of utmost importance that this field check be adhered to in making the renewals and that it be not subjected to arbitrary cuts. While there is value in checking sections of track behind the supervisor to make sure of his judgment, after a supervisor has once marked a tie for renewal, it should come out or deferred maintenance will result. Our management on the Erie has backed us fully in this policy, with excellent results.

Inspections Now Made in Spring

At one time the tie inspection was often made in the fall for the succeeding year's renewals, but since this is too late for estimates of requirements, the tendency is now to make the inspection in March and April, as soon as the frost is out of the ties. This gives as accurate an inspection as it is possible to make and promotes tie conservation. The ties to be replaced are spotted or branded at the time of inspection and a foreman must have a good reason for taking out ties not marked. This controls the situation and is subject to check. The method of marking varies, but the most usual method is to paint a spot on the web or base of the rail over the tie to come out. The use of branding hammers and the notching of the tie are also common.

It is usual to record tie renewals in main tracks by miles and sometimes by quarters, and in sidetracks by name or number. Such records or reports are valuable for rechecking, as high or low spots are apparent, and the checking often results in considerable economies. These records are also necessary for tie distribution and serve as a basis for future statistics, which, in themselves, become more valuable for estimating and checking renewals as treated ties are longer in the track. Such checks are important but they can never replace the field inspection as a basis for tie renewals.

When Should a Tie Come Out?

The question is often asked: "What prospective life should a tie have to be left in track?" After careful consideration on the Erie, we developed the following rule: In dig-in locations, ties must not be removed from the track that will last until the next working season, while in connection with full ballasting and reballasting operations ties must not be removed that are good for more than two years. The latter half of this rule is the one that provokes the most argument, but it has worked successfully. We are opposed to a four- or five-year rule in connection with full ballasting and reballasting operations.

The object of such a rule is, obviously, to eliminate the digging in of ties between reballasting operations and may be successful enough, but the price paid for it is too high. We have found that in actual practice, working on the two-year basis, there are so few ties to dig in during the third year that the scattered ones may be left in. Furthermore, main-line tracks must be cribbed and cleaned during the fourth year, at which time ties can be changed out with a minimum of labor.

Again, it must be admitted that in estimating future life we are not prone to be liberal and, therefore, shorten it too much. As a result, ties are taken out which have useful life remaining. Where digging in is done, it is recognized that a tie that will last another year might better stay in the track as its replacement can be effected just as well the next year. Since most of our main track ties are renewed because of mechanical wear, it is not so much a question of decayed ties as of the degree of checking, cutting or shattering. The timber itself is generally sound and will hold the track to gage.

Digging In Vs. Out-of-Face

The related question of whether ties should be dug in or applied only when track is raised is one that is often argued. In the days of soft ballast and when material costs were low and labor requirements for the work were small, almost all of us raised track whenever we put ties in main or side tracks. The track was given a surfacing lift every two or three years and a good railroad was maintained. Practically the same practice can be followed now on side tracks and the main tracks of unimportant branch lines, although the periods between lifts are necessarily much longer, and can be where treated ties are used. As there is little mechanical wear in such tracks, such programs are economical. Comparatively few ties need be dug in and such ties as must be, can be applied at reasonable cost. Important main tracks, however, have ties that fail from mechanical wear in spite of the best of precautions. In these tracks, the cycle of ballast work is determined by other considerations than tie renewals. Such tracks must have full tie support to insure proper riding qualities and to avoid damage to the rail which invariably results from poor ties.

Most of us clean stone ballast at intervals of from four to five years and cannot afford to take out ties with this prospective life. The result is some digging in of ties to keep up proper track conditions. We find this is not objectionable if done properly, that is, if the beds of the adjacent ties are not disturbed, and the ties are given a second tamping after settling to insure their being tight. We have developed a very effective organization of gangs and work for this purpose and have secured good results.

How Should Ties Be Distributed?

All of us remember when we received ties long in advance of their application and when our right-of-way and station grounds were full of tie piles of various shapes. The ties thus piled had to be trucked out on the track and distributed, and the labor and expense involved in doing this was largely wasted. This old practice was more or less a hold-over from making local tie purchases. Treated ties can and should be handled differently. They should be distributed directly from cars loaded at the plant, to the exact spots where they are to be applied in the track.

It is a fact that ties seasoning at a treating plant do not all mature during the renewal season and that some treated ties must be stored at the plant. However, it is much cheaper to do this with machinery at a treating plant than out on the line.

As a result of his tie inspection, each supervisor knows the exact number of ties required in each quarter mile of his territory, and the spots made at the time of inspection show just where to unload them. In view of this the ties can then be handled much more advantageously from a work train than they can be trucked from a station siding. The cost is only about half as great and the process much safer. This direct handling from the treating plant to the location of tie spot also permits the controlling of the surplus ties that were once increasing our investment in line stock, and insures that the ties get in the track the year they are treated rather than a year or two later.

Bridge and Building Men Hold Forty-First Convention

Excellent program holds interest throughout three-day meeting at Chicago—the first to be held in four years.

WITH a program embracing nine committee reports, two papers and several addresses, and a registration of 190 railway men, the American Railway Bridge and Building Association resumed its activities with a convention at the Hotel Sherman, Chicago, on October 16-18. This meeting, which was originally scheduled for October, 1931, as the forty-first annual convention, had been postponed for three succeeding years at the suggestion of the railway executives, and it was not until early last summer that the officers received the necessary assurance from the managements that enabled them to proceed with plans for the convention this fall. However, the caliber of the papers and reports presented, the active interest taken by those in attendance, the spirited discussion of the committee reports and the attention given to the exhibit presented by the Bridge and Building Supply Men's Association, show conclusively that the association is off to a good start after its period of suspended activity.

Committee Reports in Two Groups

The committee reports comprised two groups, namely, four that had been prepared for presentation at the convention that was to have been held in 1931, and five others on subjects that were completed during the past summer, after the officers of the association were authorized to plan for a convention this fall. The first group included reports on: The Maintenance of Ballast Deck Trestles; The Comparative Cost, Durability and Protective Value of Brush and Spray Painting; The Relative Advantages of Separate Versus Combined Gangs for Bridge and Building Work; and The Relative Merits of Inside Metal and Outside Wooden Guard Rails. Owing to the fact that, through special arrangements with the executive committee, these reports were published in *Railway Engineering and Maintenance* during the winter of 1931-32, they are presented here in abstract. The other five reports, which are presented in full, cover: Electric Pumping Equipment; The Relative Economy of Various Culvert Materials; Lessons from the Depression; High Early Strength Concrete—Its Place in Bridge and Building Work; and Means of Interesting Employees in Safety Measures.

Papers and Addresses

In addition, papers were presented by G. Tornes, superintendent bridges and buildings, C.M.St.P. & P., Chicago, on The Programming of Bridge and Building Work, and by C. C. Westfall, engineer of bridges, I.C., Chicago, on the Bonnet Carre Spillway Structures. There was also an address during the first session by L. C. Fritch, chief operating officer of the C.R.I. & P., Chicago, on Current Railway Problems of the Day; and Samuel O. Dunn, chairman of the Simmons-Boardman Publishing Company, and editor of the Railway Age, was the speaker at a luncheon on October 17. These papers, addresses and reports are all featured in following pages, except the paper by Mr. Westfall, which will appear in a later issue.

The convention was opened with greetings from the American Railway Engineering Association by R. H. Ford, first vice-president, and assistant chief engineer of the Chicago, Rock Island & Pacific, and from the Roadmaster's and Maintenance of Way Association by Elmer T. Howson, past president, and editor of *Railway Engineering and Maintenance.*

Mr. Ford called attention to the recent organization of the Association of American Railways, in which various phases of engineering activities have been provided for under three distinct sections, of which, and most important, a new section deals with research and development. "A prominent member of the new organization," he continued, "told me not long ago that the crisis, through which the railroads are passing, is creating what might be termed a technicians' job. You men are technicians. I am quite certain that some way will be found for the closer co-ordination of effort of organizations like your own, the Roadmaster's Association, and the American Railway Engineering Association."

Mr. Howson congratulated the association on the fact that it was one of three secondary or non-official railway associations that had been authorized to hold conventions this year, but added a note of warning to the effect that past record is not enough. "The American Railway Bridge and Building Association is on trial," he continued, "as every other association in the railway field is on trial. It has been given an opportunity to demonstrate its merit and I am sure, with the efficient personnel you have, that you are going to operate so that railway executives will say what one of the highest officers said about another association within the past few days—'Our judgment was not misplaced.'"

Election of Officers

In the election of officers, First Vice-President H. I. Benjamin, vice-chairman, committee on insurance, Southern Pacific System, San Francisco, Cal., was advanced to the presidency, while the other three vice-presidents were advanced one grade as follows: First Vice-president, T. H. Strate, division engineer, C.M.St.P. & P., Chicago; second vice-president, E. C. Neville Bridge and building master, Canadian National, Toronto, Ont.; third vice-president, A. B. Scowden, general bridge inspector, B. & O., Cincinnati, Ohio. W. R. Roof, bridge engineer, Chicago Great Western, was elected fourth vice-president, C. A. Lichty, general inspector, purchasing department, Chicago & North Western, was re-elected secretary-treasurer, and the following were elected directors to serve two years: C. A. J. Richards, master carpenter, Pennsylvania, Chicago; A. McCloy, supervisor of bridges, Pere Marquette, Saginaw, Mich.; R. P. Luck, assistant engineer, C. & N.W., Chicago.

It was voted to hold the 1935 convention at Chicago,

President Heritage's Address

President C. S. Heritage, bridge engineer, Kansas City Southern, reviewed the circumstances attending the abandonment of the conventions in 1931, 1932 and 1933, and outlined the measures taken to maintain interest in the association during the period of suspended activities. "During this time," he said, "our membership has been loyal to the association, but the many changes that have occurred in railway personnel through reduction in forces, have caused us some loss in membership. We have lost others by death. Without holding meetings, we have not been able to recruit new members in any large numbers. It is hoped, now that our meetings have been resumed, that we will see a large increase in membership. Our income has necessarily been reduced, but with strict economy we have been able to maintain a fair balance in the treasury. It is with deep sorrow," he continued, "that I must report the passing of 49 of our members during the last four years, including four of our past presidents, as well as Vice-Presidents W. T. Krausch of the Burlington, and A. I. Gauthier of the Boston & Maine, and one of our directors, J. E. King, of the Cheasapeake & Ohio."

Mr. Heritage also touched on the developments in railway transportation during the last four years, with particular reference to their influence on the work of the association. "Our association," he added, "can look forward to new activities of even greater importance than those of the past, but we must expect to make certain adjustments in our affairs to conform to the changes that are taking place in railway transportation."

Railway Problems of Today

By L. C. FRITCH

Chief Operating Officer, Chicago, Rock Island & Pacific

L. C. Fritch

IN my judgment the most important problem for the railways today is to balance the budget, which means that income must at least equal outgo. However, the drastic decline in traffic during the past five years has made it impossible for the majority of the railroads to balance their budgets, notwithstanding splendid achievements in reducing expenses. This is best illustrated by actual figures.

In 1929 the total operating revenues for the Class I railroads amounted to $6,280,000,000; in 1933, $3,095,000,000, a reduction of over 50 per cent. The net railway operating income in 1929 was $1,252,000,000 and in 1933, $474,000,000, a reduction of nearly two-thirds. To meet this drastic reduction in earnings, operating expenses were reduced from $4,506,000,000 in 1929 to $2,249,000,000 in 1933, or 50 per cent. The railroads, therefore, were successful in keeping their expenses down in proportion to the reduction in their revenues.

The only way in which the railroads can balance their budgets is either to increase their revenues or to reduce their expenses. They have about reached the limit in reducing expenses, but are now faced with an increase in wages of approximately $156,000,000 per year and an increase in the prices of materials and supplies of approximately $137,000,000 yearly. In addition, the new pension act will increase their expenses approximately $60,000,000 per annum, making a total added burden of approximately $353,000,000 per year.

Why An Increase in Rates?

How to meet these increased expenses is the most serious problem confronting the railroads. Application has just been made to the Interstate Commerce Commission for an increase in rates that will yield an annual increase in revenues of about $170,000,000, but will still leave the railroads short by $183,000,000 of the amount necessary to meet the increased expenses which they must face inevitably. The only alternative is increased revenues due to increased traffic, but on account of the low ebb of business today this is not a probability for some time. Therefore, until business conditions improve the railroads are faced with a serious problem.

It is a deplorable fact that for the first six months of 1934, in the Western region, comprising 135,000 miles of railroad, only two major lines earned sufficient money to pay their fixed charges; the rest, representing 80 per cent of the total mileage failed to earn the fixed charges. Taking the railroads in the United States as a whole, 171,000 miles out of a total of 239,000 miles of railroad, or 71.4 per cent, failed to earn their fixed charges. How long can this condition continue with the railroads still remaining in a solvent condition?

Competition Outside of the Industry

The second important problem confronting the railroads is the unregulated competition on the highways and waterways. This competition is most unfair and unjust, and it is inconceivable how the railroad industry, subjected to the most drastic regulation, can compete with other forms of transportation, which are practically unregulated. While it may be true that the country is burdened with an excess of transportation facilities, with a total estimated worth of 50 billion dollars, about equally divided between the railroads on the one hand and the highways and waterways on the other, and with traffic only approximately one-half of what it was in 1929, it may readily be seen that the need for fairness and justice to the railroads requires equal regulation and equality of competition in-so-far as the railroads and other forms of transportation are concerned, unless the public desires that the railroads shall be gradually strangled to death.

It seems incredible that the railroads should stand idly by and permit a continuation of the abuses and impositions that have been heaped upon them in the past, when they have at their ready command an economic power that is greater than that of labor, or of the other industries; namely, the interest of over fifty million people, including the holders of life insurance policies, savings bank accounts and trust estates, who are directly dependent upon the securities of the railroads. In addition, there are some twenty-five million people indirectly interested in the success of the railroads, making a total of seventy-five million people out of a total of one hundred

and twenty-five million people in this country who, if properly banded together, could demand justice for the railroads and secure it.

The competition on highways is a subsidized competition. The taxpayer pays for the highway and the railroads as a group comprise the largest individual taxpayer. The waterways are also a subsidized form of transportation and are paid for by the taxpayers. There is not a single waterway in operation that is self-liquidating. Millions of dollars are poured into waterways that are as unnecessary as they are uneconomical. A single example may suffice: The improvements in the Missouri river between Kansas City and St. Louis, costing millions of dollars, are a waste of taxpayers' money. The cost of transporting freight on this waterway has reached the surprising figure of $7,400 per ton.

C. S. Heritage
President

Mr. Heritage has served as president during the four years that the association was compelled to suspend its activities following his election to office in 1930. He became a member of the association in 1920 and immediately took an active part in its work, serving on a number of committees and presenting a personal paper on the Fire Hazard of Treated Timber, in 1924. In that year he was elected a member of the executive committee and two years later became fourth vice-president, following which he advanced steadily to the presidency. Mr. Heritage has had a broad training in bridge engineering, having seen service with consulting engineers and bridge companies in addition to his service with the Kansas City Southern, of which he has served as bridge engineer continuously since 1915.

Competition Within the Industry

The third problem confronting the railroads today is the competition within the industry, or the unjustifiable competition in services which are not in the public interest, but which are established because of the selfishness and greed of some individual railroad. This results in the final adoption of the same ruinous policy by other railroads, with a resultant loss to all. When it comes to "man's inhumanity to man," it is as nothing compared with "inhumanity of railroads to each other." Literally millions of dollars are being wasted by the railroads in this form of ruinous competition among themselves. This relates not only to service, but to rates and gratuities, in order to secure a temporary advantage.

A new organization is now being formed among the railroads, known as the Association of American Railroads, which has for its object the elimination of waste within the industry and the preservation of the railroads in private ownership. Much is expected from this organization and if it attacks these problems faithfully and aggressively much internal waste will be eliminated. The creation of this association is about fourteen years behind schedule. If it had been organized on March 1, 1920, with the advent of the Transportation Act, which for the first time guaranteed the railroads a square deal, and if the rights of the railroads under this act had been eagerly and earnestly pressed, the railroad situation might be different today. Nevertheless this new association has fertile ground to cultivate and it is hoped that it will enter actively and aggressively upon its duties to protect the railroads' interests not only from internal waste, but from political propaganda and repression from outside.

As stated above, the most difficult problem for the railroads today is to make both ends meet. Your association is to be congratulated upon the splendid efforts that have been achieved by the men you represent in fighting the battle of depression and keeping the properties in safe condition during these trying times. The greatest reduction in expenses has occurred in the maintenance of way department in which you are employed. The reduction has been from $2,554 per mile spent in 1929 to $958 per mile in 1933, or 62.5 per cent. The bridge and building department has done more than its share in meeting this situation. Under Account 208, "Bridges, trestles and culverts," $42,207,000 was expended in 1928, and this was reduced to $19,150,000 in 1932, or approximately 54 per cent. No structures on the railroads are as important as the bridges and trestles.

Optimistic About Railroads

I am optimistic about the railroads. If the plans now evolved are carried out, if the public makes the railroad problem their problem, if the seventy-five million people interested in maintaining the railroads of this country will put their shoulders to the wheel and demand equal rights and protection of this essential industry, if the railroads and other competing forms of transportations are regulated alike, if the railroads will be more humane in their treatment of each other, and if the government and labor will give the railroads a square deal, the railroads will work out their problems.

The Old Deal in Transportation

By SAMUEL O. DUNN

Chairman of the Board, Simmons-Boardman Publishing Company, and Editor, Railway Age

Samuel O. Dunn

THE period since your last convention has been one of the most remarkable in the history of the United States. Beginning late in 1929 and continuing for almost three years, the decline of general business and, consequently, of railway traffic and earnings was virtually continuous. Two years ago, in September, 1932, there were perceptible evidences that business in general and railway business in particular, were beginning to improve. Railway freight car loadings increased 30 per cent between July and October, 1932, although a 15 per cent increase is about normal during this period, and net railway operating income increased from about $12,000,000 in July, 1932, to more than $60,000,000 in October, 1932.

The improvement in business was interrupted by the banking crisis in the early part of 1933, but was resumed immediately after the banks were reopened. And then the government entered upon a program intended both to revive and reform business. As a result, general business, as shown by railroad carloadings, has been declining since March, until today the total freight business of the railroads is as small as it was at this time in 1932. During the last week, as a matter of fact, carloadings were less than they were in the same week of 1932.

Something Had to Be Done

I have participated in the criticism of the New Dealers because I have believed that many of the economic policies that have been adopted were unsound; that they would tend to start a new depression rather than help us get out of the old one; and, unfortunately, that view has been confirmed by the decline in business which has been occurring ever since March. But I don't entirely blame the New Dealers and the radicals. In large measure I blame the business interests of this country, because it was necessary for some group to come forward with measures for the purpose of improving conditions, and the business leaders of this country failed almost wholly to bring forward any such measures. Instead, they left it to government officers to bring them forward, and unfortunately, government officers did not offer the kind of measures which, in my opinion, were economically sound. To my mind, it is today the outstanding duty of business men not to support government policies that they believe are wrong, but to advocate and fight for definite and constructive policies in the place of these measures to which we object.

Recently people very high in the Administration—I do not mind saying to you that among them is the President himself—have shown great interest in the railway situation and a strong anxiety to do something to help the railroads. Constructive legislation will increase railway buying, thereby helping in the revival of the railway equipment and supply industry and the durable goods industry generally, because railway buying penetrates way back to the lumber mills in the Northwest and South and the mines in the Lake Superior region.

The New Deal and the Old Deal

We have the New Deal in business—we have the Old Deal in transportation, and the reason why I criticized the New Deal in business from its very inception was that in so many of its principles it resembles so strongly the Old Deal in transportation. But as a very curious illustration of how much difference it makes whose ox is being gored, many of the business interests who strongly object to the New Deal in business because it involves regimentation of business, government competition with its own citizens and limitation of profits, as well as unneeded expenditures for public works, are quite willing to continue to have those very same policies applied to the railroad industry.

They say, "We mustn't have government competition with industry, we mustn't have the Tennessee Valley project built because it will compete with the power companies and the coal mines." I agree with that, but how about the St. Lawrence waterway project to compete with the railways? How about the Calumet-Sag Channel project right here, which is being promoted to compete with the railroads, while they insist that the government should not engage in competition with its citizens.

This whole question of the old deal in transportation is going to be presented in a very definite way at the approaching sessions of the state legislatures and of Congress. There is no question whatever that the administration is in favor of legislation to equalize the terms of interstate competition between the railroads and other carriers. And I am very hopeful that the example that it will set will stimulate the state legislatures to adopt legislation which will, in large measure, withdraw the subsidies of carriers by highway and subject them to regulation similar to that applied to the railways.

More Constructive Policies

As to the future, I am not so pessimistic. I think the best thing that has happened during the depression was the decline in business that occurred within the last three months. That may be a surprising statement. But I feel so because I believe that the economic policies being adopted were bound sooner or later to arrest recovery and progress in the country. And the sooner they produced that effect and we were able to prove that they had produced that effect and use the proof for the purpose of getting them modified in favor of less restrictive and more constructive policies, the better it is going to be for all of us.

I am sure that the administration now realizes that some of its most important policies are failures, in the sense that however much reform they may have accomplished, they have so interfered with the revival of business that after the elections, less emphasis is going to be placed upon reform and more emphasis upon recovery. And I believe that measures promoted by business interests, which can be supported by reasons showing that their adoption will promote recovery, will receive a cor-

dial reception from members of the administration.

I think we have seen the worst of the depression. I think we have seen the worst of government policies that tend to restrict recovery. I suspect that the next Congress is going to be quite radical in its views. But within recent months there has been a great crystallizing of professional and business sentiment in this country. We have been educating ourselves in favor of more conservative policies. And with the worst of the depression behind us, with business and professional sentiment stronger for sound policies than it ever has been during this depression, with the administration groping and seeking for policies which it may use to help promote recovery, I regard the future with moderate optimism and think that we really have begun finally to start on the way out of our present predicament.

The Relative Economy of Various Culvert Materials

Committee Report

F. M. Lehrman
Chairman

CULVERTS have had the attention of the association twice in recent years:—In 1923, when a report was presented on The Relative Merits of Concrete, Cast Iron and Corrugated Metal Pipe Culverts, and again in 1928 when the specific subject was The Relative Merits of Jacking or Tunneling through a Roadbed Under Traffic as Compared with Other Methods of Placing Culvert Pipe. These reports, either essentially or incidentally, covered the field of interest in culverts very comprehensively.

No claim is made that what is presented herein is the result of original investigation, or that it replaces or supersedes either of these reports. Rather, it is presented as a compilation of information from various sources, believed to be authentic and for which proper credit will be given. In some cases it amplifies or brings down to date some phase of the previous reports, but all of the material is believed to be of interest to those who have to do with the building or maintenance of culverts.

No reference will be made herein to the previous reports, section for section, but the general sequence of treatment follows that of the 1923 report. The principal change that has taken place since that time is the more widespread use of corrugated metal pipe, which in 1923 was considered to be of too limited use to afford sufficient data on which to base definite conclusions. This material has now taken its place with concrete, cast iron and treated wood and will be given equal treatment.

Relative Resistance to Flow

For several years terminating in 1926, the University of Iowa carried on extensive tests of the flow of water through pipes, in co-operation with the Bureau of Public Roads of the U. S. Department of Agriculture. These tests have led to some conclusions pertinent to culverts. It is apparent that the maximum discharge through any pipe is obtained only when both ends are submerged and the head of water is the driving factor. This condition may not exist at a culvert oftener than once in five years or more, but when it does exist, during a severe storm that overtaxes the capacity of the culvert and water is impounded at the upstream end with its attending hazard of damage to farm lands, to the roadway and to the culvert itself through erosion, the faster the culvert will discharge the water, the less will be the damage.

It seems desirable, in view of these tests that care be taken to place pipes sufficiently low. Increased capacity can also be gained by proper design of wing walls, particularly at the discharge end. It has been shown, also, that under the conditions mentioned, vitrified clay and concrete pipe, in sizes ranging from 12 in. to 48 in., will carry off somewhat more water than a corrugated metal pipe of the same nominal diameter, this being due to the fact that the corrugations in the metal pipe set up disturbances in the flow of the water.

Service Life

In making a study of the possibility of determining the relative economy of the various materials now used in the construction of culverts, it was recognized that definite conclusions could not be reached until the life of the structures could be predicted with a considerable degree of accuracy, since the measure of economy is the cost per year of useful life. It was found that the Highway Research Board, Washington, D. C., had attempted such a project and had carried on a survey in several states, inspecting and observing a vast number of installations of all types, under all conditions of service. While this survey was productive of considerable benefit, the objective was not realized, since it was found impossible to predict the life remaining in the structures observed, from their condition at the time of inspection. While a determination of the relative economy of the various materials is to be desired, it is apparently not possible to arrive at it at this time. Perhaps it must await the time when all of the culverts which were installed, say 10 or 15 years ago, have failed from age and normal deterioration. So much money is being spent in highway construction that we can assume that the technical organizations of the highways will not rest until the matter is settled, and the vast public road system gives them a laboratory in which to make their studies.

The following figures on the costs of jacking culvert pipes through fills may be of interest for estimating purposes. They are based on a study of 21 installations involving a total length of 2,040 lin. ft. of 48-in. corrugated metal pipe installed in recent years. The requisitions on which the pipe was bought specified that the sections be punched for riveting and match-marked. The costs given per lineal foot of pipe are: Unloading $0.13; riveting $0.34; placing $1.27; excavation $1.52; jacking $1.81; total labor cost $5.07. Rental and transportation of equipment amount to $0.16; the cost of pipe and rivets is $8.11; transportation $0.56; store expense $0.16; total for the last four items $8.83; making the total average cost in place $14.07 per lineal foot.

While the gradual depletion of the nation's timber resources has made it necessary or economical to use other materials instead of wood in all but the western parts of

the country, some railroads continue the use of treated timber in the construction of box culverts; some wood-stave pipe has also been used. On one western road a large group of box culverts of creosoted pine have been in service for 30 years or more. No culvert in this group, which was installed in 1902 and 1903, has been removed on account of decay. The timber of which these culverts were built was treated by the full-cell process with an average net retention of approximately 10 lb. of creosote per cu. ft. of timber.

Preframed Timber

One railroad has recently completed and put into effect new standard plans for box culverts of treated timber, ranging in size from 1 ft. 6 in. by 1 ft., to 4 ft. by 6 ft., both single and double. The plans provide for the fabrication of the timber at the plant before treatment and field framing is limited to an occasional end cut or the boring of a hole. Instructions are provided for the field treatment of the surfaces thus exposed.

In 1927, the American Railway Engineering Association's Committee on Wooden Bridges and Trestles reported as follows: "The Southern Pacific, with more than 130 miles of creosoted pile trestle and 3,000 creosoted timber drain boxes, says from its experience that an average life of 30 years can be expected, and further states that it has hundreds of structures 29 years old and thousands 25 years old that give every promise of still being good when they reach the age of 30 years."

Timber boxes present no difficulties of erection to the railroad bridge gang. The material is easily shipped and handled, and the completed structure possesses ample strength and at the same time sufficient flexibility to adapt itself to slight movements of the fill without strain. It should be noted, however, that a timber box culvert cannot be jacked through a fill as can pipes. Therefore in replacement work, which now constitutes practically all of our construction, either tunnelling or open-cut work must be resorted to.

Reinforced Concrete Pipe

Reinforced concrete pipe continues to be widely used in sizes up to 84 in. for culverts and cattle passes. The installation in 1932 of a 72-in. concrete pipe 105 ft. long by jacking is reported. A cutting edge was provided on the foremost pipe and a bearing ring on the rear pipe. Two 350-ton hydraulic jacks were used. The speed attained was about six inches per hour. Experience in this case, where areas of foundation materials differing in supporting capacity were encountered, points to the need of some means of holding the pipe to line and grade.

Concrete pipe is a rigid structure and ultimate failure generally occurs through collapse. The signs of approaching failure are those common to all reinforced concrete structures and are generally known and readily recognizable. The various local defects, such as faulting, unequal settlement and separation at joints do not necessarily indicate imminent failure, although they may reduce the capacity of the culvert to carry off flood waters, even to the extent of making replacement necessary. These defects would be appreciably reduced if the number of joints could be reduced by making the pipe in greater lengths. This probably cannot be done without producing sections that are too heavy to handle. Where the natural ground does not afford a sufficiently stable foundation, some means should be adopted to provide such a foundation. Before depositing a fill containing boulders, a layer of earth at least a foot thick should be placed about the pipe.

The effect of the presence of alkali in the soil surrounding a concrete pipe culvert has been the subject of extensive investigation. Generally speaking, the rapidity and extent of deterioration seem to vary in inverse proportion to the quality of the concrete. Improved methods of manufacture, particularly the introduction of vibratory casting and adequate curing of the concrete before the pipe is placed in the ground, produce a concrete which is more dense and which should be more durable than that which was common ten years ago. Rigid specifications and requisite measures to ascertain that the manufacturer of the pipe understands and uses the approved methods and carries adequate stocks to insure sufficient curing time seem to be our best safeguards.

An interesting design of headwall has been developed by one of the state highway departments. It consists of a conical ring precast about the end section of pipe, the cone pointing toward the fill and the flat face flush with the end of the pipe. This retains the fill over and beside the end of the pipe and protects the fill under the end from scour. At the same time it does not present a large area to the pressure of the fill under subsidence or frost which would tend to pull the pipe apart at the joints.

Corrugated Metal Pipes

As mentioned in the introduction, there has been a very widespread use of corrugated metal pipes in recent years. They have been placed in permanent as well as temporary construction, and under both high and low fills composed of all the materials generally encountered in railway construction.

An interesting installation was made recently in the construction of a new railway line to the Boulder dam. Pipes ranging from 24 in. to 60 in. in diameter were

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(Terms Expire October, 1934)

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installed under fills ranging up to 30 ft. in height. This being a new line, all of the material had to be moved to its location on motor trucks, so that the comparatively light weight of corrugated metal pipe was a decided advantage. All of the 60-in. pipes in this group were fitted with vertical struts placed by means of jacks so as to increase the vertical dimensions three per cent and thus insure a circular section, following the deformation necessary to develop side pressure.

Flexible pipe culverts generally fail through the deterioration of the metal. Some of the conditions which are particularly destructive are: Continuous exposure to stagnant water, especially where heavy vegetation produces organic acids; the runoff of mine water or barnyard drainage; the brackish waters of tidal areas; and the alkali soils of the arid and semi-arid sections of the country. Culverts installed under these conditions should be of extra-heavy gages of base metal.

Unfortunately, it does not appear that these stages occur in all metal culverts at the same age; otherwise a numerical value in percentage could be assigned to each, and the remaining life estimated very closely. Furthermore, after stage "e," at which the spelter protection is gone, the different base metals, which may be steel, copper-bearing steel, or a nearly pure iron, may behave very differently.

A great deal is being done by the technical associations of highway engineers, by state highway commissions, and by the Bureau of Public Roads of the Department of Agriculture in the way of studies of culvert performance and the working out of standards of manufacture, installation, construction and maintenance. With the single exception that railway embankments may contain cinders in sufficient quantities to create an acid condition destructive to some materials, our problem is very similar to theirs, and those interested in the design, construction

H. I. Benjamin
First Vice-President

T. H. Strate
Second Vice-President

E. C. Neville
Third Vice-President

A. B. Scowden
Fourth Vice-President

C. A. Lichty
Secretary-Treasurer

Corrugated metal culverts should be laid on such a grade that excessive velocity of flow, with its attendant abrasion, will be avoided. If this is not possible, paving of the invert will afford some protection so long as it remains in place. Generally speaking, it appears more economical to provide sufficient extra length to protect the fill from erosion than to build headwalls.

The Highway Research Board, in the course of its survey of culvert installations, observed certain definable progressive stages in the deterioration of corrugated metal culverts which may be of interest to those having to do with the inspection of such structures. These stages have been designated and described as follows:

(a) Spelter intact and spangles (if any) clearly defined.
(b) Spelter dark and appreciably soft, spangles obliterated.
(c) Spelter dark and appreciably soft, spangles obliterated, scattered rust specks.
(d) Spelter practically gone, thin rust forming in spots, minute pits or no pitting.
(e) Spelter protection gone, uniform rust coat, may or may not have very small pits.
(f) Uniform rust, deeper pits, probably light warty or nodular growth. Rust may be tight and hard, or scaly and loose
(g) Deep pits, considerable loss of metal; generally increasing warty or nodular growth, which may be tight and hard, or loose and soft.
(h) Pits at least half through, with heavy loss of metal; cannot quite be perforated with small hand tool.
(i) Heavy warty and nodular growth, metal very thin, can be readily perforated with small hand tool, perhaps a few scattered perforations.
(j) Base metal, with frequent holes through invert.
(k) Base metal practically gone on invert; lace work.

and maintenance of culverts may find much of value in the work of these agencies. Much of the material in this paper was drawn from the various publications and other material developed by these agencies.

Committee: F. M. Lehrman (Chairman), bridge draftsman, C. & N. W., Chicago; J. J. Davis, supervisor of track, E. J. & E., Joliet, Ill.; F. R. Allen, bridge inspector, P. M., Detroit, Mich.; H. M. Arrick, research engineer, American Rolling Mill Company, Middletown, Ohio; J. E. Bird, assistant supervisor bridges and buildings, N. Y. C., Corning, N. Y.; Ira Gentis, bridge and building foreman, S. P., Oakland, Cal.; E. G. Hewson, engineer maintenance of way, C. N. R., Toronto, Ont.; A. C. Irwin, manager railways bureau, Portland Cement Association, Chicago; J. H. Phillips, bridge and building master, D. & H., Green Island, N. Y.; J. F. Seiler, field engineer, American Wood-Preservers' Association, Chicago.

Discussion

J. P. Yates (M.P.) reported good results from the use of cypress boxes when high grade cypress was available, but since cypress of lasting quality is no longer to be had, his road has used corrugated iron pipe with excellent service for a period of 15 years. In answer to a question as to the effect of corrosive tendencies on the life of corrugated iron pipe, J. S. Huntoon (M.C.) reported his observations on some corrugated pipe installed on a short railroad in 1914, on which embankments were made largely of cinders. He found that the pipe was badly corroded, but he was unable to learn whether the pipe had been constructed of durable metal. Continuing, Mr. Huntoon reviewed the practices of the Michigan Central, which constructed many stone boxes during the early

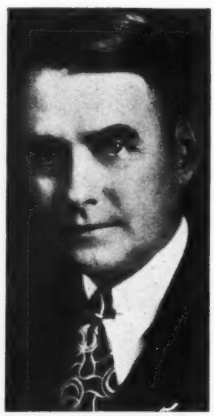
days, all of which have given very good service with a minimum of maintenance. In 1883, the road installed some "cement" pipes, all of which failed. However, concrete pipes installed subsequent to 1910 have suffered no failures at all. A considerable number of boxes constructed of creosoted hemlock rendered good service, except where the pieces had been cut in the field, while pine boxes rendered a service of 27 years with good results.

L. D. Hadwen (C. M. St. P. & P.) said that culverts installed too low in flat country will have a tendency to fill with sediment. A. B. Scowden (B. & O.) called attention to the extensive increase in the use of corrugated metal pipe since the presentation of an earlier report on the subject of culvert pipes. He reported that the B. & O. had installed many corrugated culvert pipes that are rendering excellent service, especially where they have been installed under existing embankments by jacking. When installed in new work, there is some tendency for the pipes to flatten when the embankment is placed. In commenting on this point, H. I. Benjamin (S.P.) stated that all culvert pipe placed under new fills should be strutted to avoid distortion in the pipe until the embankment has solidified.

T. B. Turnbull (A.A.) said that he has installed a number of corrugated culvert pipes by means of jacking, including one of 60-in. diameter and a number up to 48 in. in diameter, and reported that the labor charge ranges from $4 per lineal foot for culverts installed in clay or earth fills, to $6 for culverts placed in sand. He also endorsed Mr. Hadwen's comments on placing culverts too low, but called attention to the hazard of damage claims if they are placed so high as to cause the water to back up during periods of heavy discharge. He also advocated the installation of culverts not less than 24 in. in diameter because of the extreme difficulty experienced in efforts to clean pipes of the smaller sizes.

Electric Pumping Equipment

Committee Report



B. R. Kulp
Chairman

ONE of the essentials in the operation of steam railroads is a suitable water supply. This not only contemplates water of satisfactory quality and quantity, but more important in the actual operation are the facilities which will enable the water to be delivered to the service tanks with the least possible delay and at minimum cost.

The history of railway water supply is a story of the constant change and reconstruction of pumping facilities before they have exhausted their useful life, by reason of the introduction of new methods of pumping and the demand for water of better quality in larger quantities. The principal factors in this change have been the development of pumping equipment, changes in operating conditions and the necessity for greater economy in railroad operation. The two important factors making this operation possible are the storage facilities and, of prime importance, the pumping equipment which delivers the water from the source of supply to the storage facilities at the maximum rate and the lowest cost.

Water, when not furnished under pressure from municipalities, is secured mainly from deep wells, shallow wells, lakes, ponds, streams and reservoirs, and is delivered to the service tanks by various types of power-driven pumps. Since the primary purpose of railway water service is to insure a dependable supply of satisfactory water, available for delivery to locomotives, the pumping plants are sensitive to changes in equipment.

Historical

The history of the early operation of railroads shows that the first pumps were manually operated. From such primitive facilities, pumping equipment has passed through various stages, both as to the construction of the pump and the kind of power used to operate it. Undoubtedly the first substitute for man power in pump operation for railway service was the windmill. The first steam-power pump prior to 1870 was the reciprocating surface pump which was used to deliver water from open wells, and was usually installed on a platform near the bottom of the well. During the period between 1870 and 1875 the steam-head pump of the single-plunger type was developed to deliver water from drilled wells, thereby making it possible to obtain a more satisfactory quantity of water at a more uniform rate during the various seasons of the year. Pumps of this type were used extensively by the railroads until 1900, and many of them are still in service, but adapted to other power drives. This single-plunger type was followed by the double-acting cylinder pump, which delivered approximately fifty per cent more water without increasing the size of the well. Following the double-acting cylinder pump came the two-plunger pump, and about 1910 the deep-well turbine pump began to receive favorable consideration. During this same time, the air lift system of water delivery was also introduced, but it is not capable of general application.

The early types of pumps were driven by steam, but the development of oil and gas engines led to the adoption of this new type of power in many cases. Thereafter, in the newer installations considerable thought was given to the type of equipment and power to be installed, the decision being generally based on conditions existing at the location in question.

Progress in Modernization

During the past 15 years, notable progress has been made in the modernizing of pumping facilities, made necessary by the increased demand for water and rearrangements in train operation. Many of the old water stations throughout the country have been rebuilt along modern lines. Electrically-operated centrifugal pumps are now used in place of plunger pumps in wells and have even supplanted triplex pumps operating against heavy pressure. Electrical apparatus, including floats and time switches, has been installed so that many pumping plants are now started and stopped automatically or by remote push-button controls.

In the opinion of the committee electrical equipment

possesses the following advantages: Electric motors are smaller than other types of power units of the same capacity and therefore, require smaller space for installation and lighter foundations; they can be housed in a smaller building; are simple in operation; and are adapted to automatic control. They have long life and the initial cost is low. The controlling advantages effected through the use of electrically-driven pumps in most installations are the reduction in cost of attendance and, to a lesser extent, the lower initial cost of the plant and lower cost of maintenance. The cost for electric current will, in many cases, exceed the cost of steam, as far as power is concerned, and will greatly exceed the power cost of oil-engine operation. Therefore, unless a particularly attractive rate can be obtained or other conditions make it advisable to use electricity, electric power will prove desirable and economical only where reductions may be effected in attendance costs.

As to the disadvantages: Electric motors can be used only where electric power is available in the vicinity of the plant. There is also the risk of interruption in power service on account of storms and other conditions that interfere with the transmission lines. The cost of power may be prohibitive. The motors must be located above high-water elevation to insure against damage during floods. There are also extreme cases where it is necessary to construct long transmission lines. The cost of such a power line may greatly exceed the cost of the pumping equipment.

Primary Considerations

The trend of the present-day practice when rebuilding or installing water stations is to make a survey to determine the most economical equipment and the kind of power suitable for the location. In considering the kind of power to be used the following general considerations should be taken into account:

1. Location of the water station.
2. Power available and its cost.
3. Consumption of water per day.
4. Initial cost of installations.
5. Estimated maintenance cost.
6. Available attendance.
7. Amount of water furnished per unit of energy used.
8. Character and dependability of the supply.

Modern power installations are confined almost altogether to the use of semi-Diesel oil engines or electric motors. While engines of the semi-Diesel type produce power at a much lower cost for power alone than electricity, there are other factors that must be considered, as for example, the first cost of the unit, the additional housing required, and the attendance and maintenance charges, which are invariably greater with the oil engine than with the electric unit.

Electricity was first utilized to drive the various types of pumps about 1900. The automatic control of electrically-operated pumps was developed about 1917, although both the Missouri Pacific and the Illinois Central claim to have had complete automatic pumping stations in service long before that year. These earlier automatic pumping plants were operated by mule power. According to tradition, a blind mule operated a turnstile arrangement to drive the pump, the power plant being located beneath the tank. The mule kept plodding along until the water overflowed from the tank and fell upon him, whereupon he would stop automatically. After resting a considerable length of time he would again start his endless journey and continue until the tank overflowed once more. Unfortunately complete details of this installation are not available.

Undoubtedly the most common electric pump in use on the railroads today is the horizontal centrifugal pump. The combination of a centrifugal pump directly connected to an electric motor makes a more compact pumping unit than can be obtained with any other type of power. This, in turn, decreases the cost of housing and installation.

Selection of Pump

The development of the electrical pump and the extended use of electricity have made this type of pump available as an economical means of handling both large and small quantities of water under average conditions. In selecting the pump it is very important, from the standpoint of economy, that the pumping units be of a proper design to meet the individual operating conditions with reference to delivery and head. The centrifugal pump is less flexible in operation than many of the other types with respect to suction and delivery heads. In the endeavor to increase the flexibility of this type of pump, various expedients are resorted to, such as the use of a variable speed induction motor, and secondary pumps of similar and varying capacities, as well as standby units driven by other sources of power. However, these expedients increase the cost of installation and maintenance.

In the installation of a horizontal centrifugal pump, care should be taken to insure that the suction lift will not exceed 17 ft., and preferably 10 ft. Where these conditions are observed, these pumps will usually operate satisfactorily, sometimes giving an overall efficiency as high as 83 per cent. They can sometimes be so located that they will not freeze during cold weather. If this is not possible, provision must be made to protect the equipment by elaborate frost proofing, automatic heating or by providing an attendant.

Well Installations

Electric power is particularly adapted to pumping from wells. The deep-well turbine or vertical centrifugal pump will deliver more water from a well of a given size and capacity than any other method of pumping with the possible exception of the air lift. For those installations where a horizontal pump cannot be utilized, as in the case of a deep-well supply, a vertical centrifugal pump of small diameter has been developed that can be installed inside a well casing. This pump is driven by a vertical motor above the well which is connected to the pump by a vertical shaft of such length that the pump can be placed below the lowest draw-down water level, so that the pump runners will be completely submerged at all times. Due to the limitations of construction and the transmission losses of the long line shafts, these pumps do not have an average efficiency of more than 50 per cent. As the pump is always submerged and consequently primed, no difficulty attends its frequent starting and stopping by means of automatic control. In many vertical centrifugal pump installations the water is taken from the vertical well casing at a point below the floor line, so that the discharge line will also be below the frost line, thereby eliminating the necessity of protection from freezing.

Deep well turbines are available in capacities of from 100 to 5,000 gal. of water per minute and for use at depths of from 20 to 500 ft. Where the pumping lift of the water is more than 500 ft., the air lift is more desirable than the shaft-driven turbine pump because of the difficulty of maintaining the long shafts. A combined pump and motor that may be submerged in a well at any depth, thus eliminating the necessity for a vertical shaft, is in the process of development and when perfected will overcome the objection to long shafts and make the deep-well turbine adaptable to wells of practically any depth.

In point of cost of the power used, the four types of pumping equipment fall in the following order, with the least expensive at the head of the list: Gasoline or oil engine-driven pumps, steam-driven pumps, electric-driven pumps, and air lifts. It should be born in mind that this applies to power costs only. If attendance charges can be eliminated by using automatic or remote control, electricity usually becomes the most economical power, oil, steam and air following in the order named.

Power pumps of the simplex, duplex and triplex types are also adapted to electric drive and make very compact and efficient units. Power pumps may be driven either direct through reducing gears or by belts, the latter method being preferable in most instances. While the belt drive generally calls for a larger house in order to obtain the proper belt centers, it provides smoother operation and has a tendency to reduce maintenance costs.

Automatic Control

Practically all types of electrical pumping equipment are adaptable to automatic control, of which there are several types. One of these is the float switch which will operate satisfactorily in warm climates where there is no danger of freezing. Another is the pressure type which will give satisfactory results as long as no obstruction is present in the pump, or as long as the velocity pressure can be maintained on the facilities.

One of the most common automatic controls now in use is the mercury switch control. A typical installation of this consists of a one-inch pipe approximately eight feet long within a pipe of a larger diameter, hermetically sealed at the top and bottom and located in the storage tank. This arrangement of double piping is used to insure an air space around the inner piping to prevent freezing of the water in it. This inner pipe is open at the bottom, thus allowing water to rise in the pipe, which in turn compresses the air within, thereby generating the force to actuate bellows located at the top. Above the bellows is a compensating spring which reverses the action of the bellows as the water is lowered in the tank. The operation of the bellows in turn actuates a mercury tube which opens or closes the contacts which start and stop the electrical pumping equipment. The mercury switch, if properly installed, operates at practically no cost and with a minimum of maintenance under all climatic conditions. Some railroads use a combination pressure and mercury-tube control, tapped into the discharge line from the pump.

Recent developments have shown the desirability of a new type of pump adaptable to many present railway installations. This pump should include the prominent features of both the horizontal centrifugal type pump and the deep-well turbine. It should be a self-contained unit of the vertical centrifugal type, especially designed for settings in dug wells from 15 to 65 ft. deep.

Many railroad water supplies are obtained from dug wells or intake sumps on the banks of streams. The original installations were for the purpose of providing a screened intake for the suction lines of steam pumps. In some of these installations the water level is subject to seasonal variations of as much as 60 ft., making it necessary to reset the pump frequently. For this reason a vertical centrifugal pump, with the motor set above high water level and the pump at the lowest draw-down level in the well, will operate satisfactorily at low cost. The discharge can also be kept below the frost line, thus making it possible to provide complete automatic control at all seasons of the year. A pump of this type is now manufactured for handling sewage. Its main disadvantage is a low efficiency rating, but with slight mechanical changes this rating can be raised to approximately 80 per cent, thus making it a more desirable pump than those now used at many railroad water stations.

The Influence of Power Rates

An important factor in the cost of electricity for the operation of pumps is the standby cost, which is an arbitrary charge regardless of how much current is consumed. In small pumping stations, where little power is required, this standby charge often makes the installation of electric pumping units prohibitive. In the larger stations where the power consumption is reasonably high the standby charge is not of such great importance, as it is readily absorbed in the power cost.

While it is desirable to have motors of ample size to prevent overloading, the standby charge, as well as the lower efficiency, makes it desirable to avoid installing motors greatly in excess of the power requirements. Economies in the standby charge may also be effected by installing units of such size that the pumping time may be spread over periods of from 16 to 20 hours, except where attractive rates for off-peak loads may make it desirable to confine the pumping to the hours when the lower rates may be obtained.

Standby Units

Motor-driven equipment should be installed in duplicate at all important stations; and where there is any possibility of interruption to the service because of storms, transmission trouble or for other reasons it is advisable to install standby equipment driven by prime movers. In cases where motor-driven pumps are installed at existing pumping plants it is frequently desirable to retain the old pumping equipment for standby service. Compensator and automatic control panels should also be installed in duplicate and arranged in such a manner that either panel can operate the pump, as this will frequently avoid interruption to service because of electrical storms.

In considering new installations or the reconstruction of pumping plants now in service, the decision as to the type of equipment should always be governed by local conditions. Each of the various types of power should be given consideration, making comparative estimates of the cost of pumping per 1,000 gal. of water delivered. These estimates should take into account the carrying charges on the investment, and the cost of operation and maintenance, including labor and supplies as well as the cost of the power.

Committee: B. R. Kulp (Chairman) principal assistant engineer, C. & N. W., Chicago; E. N. Bishop, supervisor water supply, C. & O., Huntington, W. Va.; R. C. Henderson, master carpenter, B. & O., Dayton, Ohio; G. E. Boyd, associate editor, Railway Engineering and Maintenance, Chicago; C. R. Knowles, superintendent water service, Illinois Central, Chicago; J. W. Porter, principal assistant, C. N. R., Winnipeg, Man.; F. M. Sloane, division engineer, C. M. St. P. & P., Milwaukee, Wis.; L. C. Smith, supervisor bridges and buildings, Indiana Harbor Belt, Calumet City, Ill.

Discussion

R. C. Bardwell (C. & O.) emphasized the fact that while the demands of economy and efficiency in the operation of water stations are so insistent that progress toward better and more dependable methods of pumping cannot be retarded, the officers responsible for the water department must take into consideration the changes in organization that will be necessary in connection with new methods. Few water service organizations include

electricians, for which reason it is necessary to call on the electrical department when anything goes wrong with electrical equipment. This often leads to a division of responsibility and sometimes to disputes as to the responsibility for poor operation. Another factor that must be considered is the displacing of older employees through the installation of automatic pumping equipment.

R. L. Holmes (T. & P.) stated that his road has electrified practically all of its pumping stations within recent years. The water service department does not include electricians and many of the plants are difficult to reach from central headquarters. For this reason the plan has been adopted of calling on signal maintainers to handle the electrical work in connection with these installations, and this has proved quite satisfactory. Some of his stations are in areas where low winter temperatures prevail, and from his experience he emphasized the need for proper arrangements for heating electrified water stations in cold weather. He also called attention to trouble that sometimes occurs with deep-well electric pumps from lubricating oil getting into the water. This may not be serious at heavy locomotive water stations, but where the water is also used for drinking purposes, some means must be provided to eliminate this trouble.

J. A. Andreucetti (C. & N. W.) said that his road has electrified about 50 water stations during the last 10 years and that no question had arisen regarding division of responsibility between the electrical and water service departments. He called attention to the fact that in late installations, ball-bearing motors have been used, as a result of which maintenance on this equipment has been reduced almost to zero. The principal trouble with the motors with the ordinary type of bearing occurs in the lubrication, but with the ball-bearing type, attention every four months is sufficient to keep them properly lubricated. E. M. Grime (N. P.) cited one station where electrical operation is saving $1,400 a month, as compared with steam operation. He is using electrical equipment wherever practicable when modernizing water stations.

In reply to a question from the floor, C. R. Knowles (I.C.) replied that the committee does not recommend any particular type of automatic or manual control, but is of the opinion that each case should be decided in the light of local conditions. Mr. Andreucetti added that the mercoid control is the most practicable for general application to pumping installations.

Means of Interesting Employees in Safety Measures

Committee Report

F. H. Masters
Chairman

IN the preparation of a report on "safety" it is almost impossible to avoid a restatement of what has been said or written before. On account of the importance of the work, the various phases have been discussed many times, until at present no one in the employ of a railroad can plead ignorance as an excuse for carelessness. However, all men are not naturally careful, and even when they are familiar with the dangers connected with their work there are those who continue to take chances and run the risk of injury. Results in safety work will come only after all employees are educated in the subject to such an extent that they will acquire an honest desire to perform their duties with a proper regard for their own welfare and that of their fellow employees.

Must Have the Support of All Officers

Accident prevention on a railroad must have the interest and support of the highest executive, and must extend from him down through the official and supervisory forces without exception. Only then can the rank and file of employees be expected to do their part. If somewhere in the line of supervisory officers, between the highest officer and the workmen in a gang, there is someone who is not completely "sold" on safety, who regards it as more or less of a nuisance and a hindrance to the rapid performance of work, who enforces the safety rules merely because he is told to do so—that person will do an immeasurable amount of harm and will retard the sincere efforts of those who really are interested in this work. Those working under him will be quick to sense his attitude, and their interest will decrease accordingly. There should be no place on a railroad for an officer or supervisor who assumes this attitude.

Therefore, the first requisite in this work is a properly organized safety department that has the sincere support of the management and of all those employed in official or supervisory capacities. It is only through this that the first and most important requirement of safety can be carried out—the furnishing of the employees with a safe place to work and with the proper tools and equipment with which to do their work. Without these, it would be as futile to expect the rank and file to take a proper interest in safety as it would be to expect them to perform their work properly with makeshift or defective tools and equipment. It is rather discouraging to the safety inspector to talk safety to a gang of men and urge them to work safely, when they point out to him some dangerous working condition that they have asked to have remedied but which the officer in charge has neglected to give his attention. A man certainly should not be expected to work safely when he is surrounded by hazards that are apparent to him, but which his superior makes no effort to remove. Therefore, in order to keep alive the interest of the rank and file in the prevention of accidents they must first be provided with a safe place to work, with safe working methods and with safe tools and other equipment.

A Book of Rules

To avoid the dangers connected with his work the employee must be familiar with them. This brings us to the necessity of furnishing each employee with a book of safety rules and cautions. Practically every railroad has its own book of safety rules, and while the rules do not cover all causes of accidents, they do embrace those that are the most common and give rise

A Group of the Convention Party in Front of the Ford

to the greater proportion of the accidents that occur.

The book of safety rules should be prepared by the safety department, with the co-operation of the various departmental heads. Each department of the railroad should have its own book of rules, which should embrace first, the general rules that apply to all departments, and second, those rules that affect only the department for which the book is issued. In this manner an employee is not provided with a book that contains rules which do not affect his work and in which he has no particular interest.

Rules Must be Read

It is not enough, however, merely to place the book in the hands of the employee. The foreman or supervisor must see to it that each of his men has read and understands the rules, and that they are lived up to. Otherwise they are valueless.

The complaint is sometimes made that the strict observance of safety rules slows up the work and increases the cost of some particular job. It takes a certain amount of time, for example, to put on a safety belt and attach the safety rope when working aloft, or to put on goggles where there is a possibility of eye injury, and sometimes a foreman who is eager to do his work rapidly and cheaply may be tempted to take a chance and allow his men to work in violation of the rules. The small saving thus effected will not compare in any degree with the time lost or the expense incurred when an accident occurs as the result of such a violation of rules. If the humane side of the question does not appeal to the foreman, and he is concerned only with the cost of a particular piece of work, he should take into consideration the heavy expenses that may be incurred in the event of an accident.

The Foreman Is the Key Man

It goes without saying that the foreman has a greater opportunity for interesting the rank and file of employees in safety than anyone else. He is familiar with the work to be done and knows just how it should be done. He knows, or should know, the hazards connected with the work under his supervision and how they can be avoided. He knows what tools or machinery should be used in certain kinds of work, and through periodical inspections can easily tell when any equipment is unfit or unsafe for use.

The foreman can contribute greatly to the safe performance of work by the exercise of care in the selection of men. Comparatively few roads require physical examination for maintenance of way employees, but the foreman can at least ascertain whether or not an employee's sight and hearing are sufficiently defective to constitute a hazard to himself and his fellow employees. If a man has any defect that apparently renders him unfit or unsafe he should be barred from employment. The foreman who watches this closely is not only protecting the interest of the railroad but is securing the confidence of his men, who will thus realize that he is careful not to establish any unnecessary hazards in connection with their work.

Interest Must Be Real

A foreman who is not interested in safety should not be permitted to continue in charge of a gang of men. If he ignores and fails to enforce the safety rules, if he closes his eyes to unsafe conditions or working methods, if he permits the use of unsafe tools and equipment—certainly the men working under him cannot be expected to work safely or to take an interest in the prevention of accidents. The foreman's interest in safety must be real. He must not only preach safety but must practice it. To quote from a recent bulletin issued by another industry, "Safety is not a thing to be isolated from our general working habits. Safety is a generalized habit just like honesty. You do not get up in the morning and say to yourself 'I'm going to be honest today.' A great many persons think safety means simply the avoidance of danger when, as a matter of fact, it is the business of performing your occupation in a certain way."

On one railroad each foreman is required to make a monthly report, fully covering his safety activities during the previous month. This report embraces any changes in working conditions or methods that he has made, any violation of safety rules that have come to his attention, the dates of inspections of tools and equipment, a statement of accidents that have occurred to men working under him, and any safety recommendations that he may have to offer.

Many roads issue safety bulletins to their foreman, showing the accident rating of various departments, a description of accidents that have occurred and other information that should be helpful to the foreman. Divisional safety meetings at which general conditions and a certain number of local problems can be discussed are desirable, but are often impracticable because of the difficulty of taking men from their work. More effective results are obtained by having the foreman take a little time each day to discuss safety matters and to examine the men on safety rules.

Building at A Century of Progress Exposition

Many roads have division safety committees which meet at stated intervals to discuss the correction of unsafe conditions, and these men in their daily work should be expected to call the attention of any foreman to unsafe practices or conditions that apply to his work. However, this supervision, like that by department heads, necessarily is infrequent and, as previously stated, the foreman of the gang is the one who must be depended upon to promote the safety movement.

One road has secured very good results in interesting its employees in safety through an annual two-weeks' safety campaign. Prior to its inauguration, this campaign is extensively advertised among the employees by means of bulletins, and all are asked to help in the attainment of a perfect record during the period of the campaign. During the course of the campaign, members of the safety committees and of the safety department go among the employees, distributing safety literature and discussing matters of safety with them. While a perfect record has not always been attained, the interest aroused through these campaigns has had a very beneficial effect on the accident record for some time following a campaign of this kind.

The use of bulletins in keeping up the interest of the employees should not be overlooked. Men will pay more attention to a notice on a bulletin board than they will to a letter or pamphlet and the safety department should see that bulletins are posted frequently.

The placing of a sign reading as follows: "This Gang Has Gone —— Days Without An Accident" will aid in stimulating the interest of the men. This record should be changed daily.

Practically all railroads furnish goggles to employees whose work may require their use. These goggles should be of an approved type, and where necessary, employees should be furnished with goggles especially fitted for their eyes. Nearly all railroads have also adopted some plan of providing safety shoes that may be purchased by employees. The wearing of these shoes not only prevents foot injuries but also impresses on the employee the necessity of working safely.

Suggestions Should Be Solicited

Employees should be encouraged to make safety suggestions either to their superior officers or to members of the safety committee, and every effort should be made to assure them that such suggestions will not prejudice anyone against them. All such suggestions should be promptly acknowledged, carried out when possible, and the employee should be advised of the action taken. On some roads the awarding of prizes to gangs having the least number of accidents introduces a competitive element into the work and aids in stimulating interest.

The desire of every safety department is not only to provide safe working conditions but to educate each employee so that safe performance of his work becomes a habit, and the more nearly this is accomplished the better will be the accident record of the railroad. However, to repeat what has already been said, it is first necessary to furnish the employees with a safe place to work, with safe working conditions and methods, and with safe tools, machinery and equipment. Second, it is necessary that the supervisory forces, without exception, take the proper interest in the work, as already outlined. Without these requisites the efforts of the safety department in educating the rank and file of employees will be wasted.

Committee: F. H. Masters (Chairman), assistant chief engineer, E.J. & E., Joliet, Ill.; C. W. Wright, master carpenter, L.I., Jamaica, N.Y.; W. R. Fithian, assistant engineer, M.P., Osawatomie, Kan.; H. Heiszenbuttel, supervisor bridges and buildings, C. & N.W., Norfolk, Neb.; J. P. Hofacker, supervisor bridges and buildings, L.V., Auburn, N.Y.; C. L. Metzmaker, supervisor bridges and buildings, C. & I.M., Springfield, Ill.; R. W. Mitchell, general foreman, B. & O., Baltimore, Md.; W. A. Stewart, assistant supervisor bridges and buildings, Cen. Vt., New London, Conn.

Discussion

O. W. Stevens (D. & H.) in commenting on that portion of the report with respect to the foreman being the key man in safety work, said that on his road one man in the gang acts as safety agent for one week, giving place to another for the following week. This man makes reports and collects suggestions from men in the gang, which he includes with the report. These reports and suggestions are sent to headquarters and are discussed at the monthly safety meeting.

H. Cunniff (D. & H.) added that while this practice is universal on his road, the foreman is always the safety agent and makes regular reports on safety matters, but that the safety man in the gang also acts subordinate to, but independent of, the foreman in these matters.

T. H. Strate (C.M.St.P. & P.) said that it was the custom on the Milwaukee to consider the assistant foremen in large gangs as safety men. This practice does not relieve the foreman of any responsibility, but serves to encourage a wider interest of safety matters. Responsibility is also put on the individual men in the gang, and the road has issued a bulletin outlining these responsibilities. This road has taken the position, which it impresses on every supervisory officer, that the remedy for

improper practices is education and constant supervision.

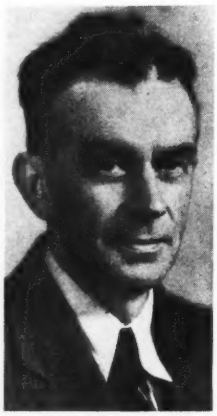
P. Paulson (C. & N.W.) told of the practice which he has followed for a long time of requiring each foreman to hold a safety meeting every Monday morning. In his daily report, the foreman must state what subject was discussed at this meeting and forward suggestions made by any of the men.

Commenting on the section of the report concerning reluctance on the part of the men to make suggestions, E. C. Neville (C.N.R.) said that the Canadian National had distributed cards for safety suggestions but found it very difficult to get these cards returned, as the men were timid about making suggestions for fear that superior officers might be inclined to criticize them in some cases for doing so. After a somewhat extended campaign, the men now realize that this is not true, and the cards are being received in relatively large numbers. As a result of this practice, many conditions have been corrected which might otherwise have passed unobserved until personal injury resulted. He recommended a thorough investigation to determine the cause of every accident and believed that when the investigation is completed, a communication outlining the accident and the results of the investigation should go to every man in the territory. This road also has co-operative committees in the maintenance of way department, organized by divisions. The committee encourages the men to bring in suggestions for improvements and if these corrections can be made locally, this is done. If correction is beyond the authority of the local committee, the suggestion is passed on to higher officers who are in position to authorize the work necessary to make the desired correction. Commenting also on the foreman as the key man, he thought that while no responsibility should be taken from the foreman, the organization should be such that the entire gang will co-operate in safety matters and a regular campaign of education should be carried on through this channel.

J. J. Davis (E.J. & E.) agreed that every accident should be investigated and his experience indicated that excellent results can be obtained from this practice. He also emphasized the desirability of discouraging foremen from being away from the gang during working hours for any cause. He said that there are few cases where the errand cannot be done by some one in the gang.

High Early Strength Concrete—Its Place in Bridge and Building Work

Committee Report



L. B. Alexander
Chairman

IT IS common practice to allow concrete to cure for 14 to 28 days before placing it in service. In railroad work, this loss of time is frequently very objectionable. It may involve delays that increase the cost of operation, engender bad public feeling because of interference with vehicular traffic, increase the expense for rented facilities, delay the early completion of a structure intended for highly competitive use, and cause other losses, some tangible and many intangible, but none the less real.

In order to minimize these objections, concrete of high early strength has come into use. It supplants ordinary concrete only in those cases where early use justifies the additional expense.

High-early-strength concrete is a concrete that will attain strengths capable of carrying specified loads or of resisting abrasion in a shorter period of time than is possible with ordinary methods or materials. It is usual to expect working strengths in from 24 to 72 hours.

High-early-strength concrete may be obtained in three different ways:

1. By special manipulation with standard brands of portland cement.
2. By the use of admixtures with standard brands of portland cement.
3. By the use of special high-early-strength cements.

Cement of different brands varies in the rate at which it attains strength, although the difference tends to disappear at greater ages. In the absence of definite information on this point, tests should be conducted to ascertain the particular brand that will furnish the desired strength in the allotted time.

Having determined the brand of cement, high-early-strength concrete is possible because of a few important factors. In general, those factors which increase the strength of concrete in 28 days, increase the strength at early ages relatively more. Any measure that will double the 28-day strength will much more than double the 3-day strength. Tests show that a concrete designed to develop 3,000 lb. per sq. in. at 28 days, will under ordinary conditions attain a strength of 900 lb. in 3 days, while a concrete designed for 6,000 lb. at 28 days would attain a strength of 3,000 lb. in 3 days.

The effect of changing the quantity of mixing water is well known. An increase of about one per cent of water results in a reduction in strength of about five per cent at one or two days. By the selection of a low water-cement ratio it is possible to design a mixture for a specified strength in three days which is certain to result in high ultimate strength. Furthermore, the dense paste resulting is certain to contribute to the durability of the concrete when exposed to severe conditions.

In addition to the selection and rigid maintenance of a low water-cement ratio, an increase in the mixing time increases the ultimate strength as well as its strength at early ages. Tests indicate that doubling the time of mixing increases the strength about ten per cent.

High early strengths can be expected only when the temperature conditions for placing and curing are favorable. The chemical action of the hydration of cement is accelerated by the application of heat, and the gain in strength is greatly retarded by temperatures below 45 deg. F. For high early strength it is important that the temperature of the mix when placed should be between 70 and 100 deg. F., and that these temperatures be maintained for as long a period of time as possible after placing. The aggregates and water should be heated, if necessary, to obtain these temperatures, and care should be observed to prevent chilling of the concrete.

There is possibly no cheaper way of securing strength in concrete than by proper curing. The gain in strength stops as soon as the concrete dries out. It is especially important to keep this fact in mind when materials are heated because of the rapid evaporation. Such concrete should be kept thoroughly and constantly wet, and moisture should be applied a soon as possible after setting. By means of mechanical vibration it is possible to secure a dense strong concrete with resulting economy in the use of cement and a decrease in the shrinkage because of both a low water-cement ratio and low cement factor.

Range of Strengths

The following table is suggestive of the range of strengths possible with variations in the water-cement ratio. These data are based on laboratory tests, and the early strengths are subject to increase through control of the above factors. However, these strengths cannot be expected in the field unless the proper water-ratio, temperature and curing conditions are rigidly maintained.

Gallons of water per bag of cement	Compressive strength—6 in. by 12 in. cylinders (cured wet until tested)				
	1 day	2 days	3 days	7 days	28 days
3.7*	2,000	.....	.....	.....	.....
4	.....	2,500	3,400	4,600	6,000
5	.....	1,600	2,300	3,500	5,000
6	.....	1,000	1,500	2,500	4,000

*Mix 1-1.51-2.87 by weight (7.7 sacks per cu. yd.), tamped into 6-in. by 12-in. cylinders in 2-in. layers.

Admixtures with Standard Brand Portland Cements

Admixtures that act mechanically to increase the plasticity of a mix, contribute little to the strength of concrete, and have no place in this report. However, admixtures that act chemically as accelerators can often be used within certain limits to obtain high early strength. Of these, the most common is calcium chloride. Calcium chloride does not react with all brands of cement in the same way, so it is well to make preliminary tests. Generally, from two to four per cent, by weight, of the cement, dissolved in the mixing water may be used. Larger amounts have a tendency to produce a flash-set.

Any accelerator which is corrosive to steel should be used with discretion in highly reinforced concrete, as cases are known where corrosion of the reinforcing has caused extensive failure of the concrete. The committee has no evidence that calcium chloride as an admix produces corrosion.

Accelerators should not be used in reinforced concrete structures that will be exposed to stray electrical currents. There are also admixtures on the market which will produce a flash-set in various periods of time down to a fractional part of a minute. These admixtures are rather expensive, but are useful in shutting off leaks of water through concrete.

High-Early-Strength Cements

The dividing line between high-early-strength cements and ordinary portland cement is becoming less distinct than in the past. Special high-early-strength cements should comply with the Tentative Specifications and Tests for High-Early-Strength Cement prepared by the American Society for Testing Materials. With these cements, concrete of a high early strength may be obtained with a mix of customary proportions, consistency, ease of handling and workability. It is possible to produce 4,000-lb. concrete in 24 hr. Even this strength may be exceeded by the addition of an accelerator to a mix involving the use of high-early-strength cement—in some cases strengths in excess of 6,000 lb. have been obtained in 24 hours. While it is not possible to discuss here the merits of the various brands of high-early-strength cement, there are a number on the market which, from information received in response to inquiries, are proving satisfactory when used in accordance with the requirements of the water ratio, placement, temperature and curing as discussed under, "Standard Brands of Portland Cement." The manufacturers of some special cements provide special instructions applying to their products, which must be rigidly complied with in order to produce recommended and desired results. In this connection the committee calls attention to parts of an excellent report on Concrete Construction published on pages 38 to 42 inclusive of the 1927 proceedings of the American Railway Bridge and Building Association, which cover such subjects as "Quick Hardening Concrete," "Portland Cement Concrete of High Early Strength," "Hardeners for Portland Cement Concrete" and "Special Quick-Hardening Concrete."

The cost of any high-early-strength concrete as compared with 28-day concrete varies chiefly with the cost of the cement used. This may be estimated readily for any particular case and the added cost balanced against the savings. The additional cost for handling, curing and protecting may, in some cases, show an economy when a curing time of 1, 2 or 3 days is compared with the cost of properly curing 28-day concrete.

The following table gives a rough comparison of the relative cost of using standard portland and high-early-strength cement:

			Difference in Cement		Difference in Aggregate		Difference in Cost
Water—gals. per sack of cement	Strength 28 days	Bbl. per cu. yd.	Sacks per cu. yd.	Diff. in Cost ($)	cu. yd.	Cost ($)	($) per cu. yd. net
6¼	2500	1.28	0	0	0	0	0
5½	3000	1.45	†0.7	†0.27	‡0.14	‡0.14	†0.13
5	3500	1.67	†1.6	†0.62	‡0.23	‡0.23	†0.39
4½	4000	1.92	†2.6	†1.02	‡0.35	‡0.35	†0.67

†Indicates increase. ‡Indicates decrease.

The portion of the table covering cost is based on quantities taken from a chart developed by the Chicago & North Western, which is based on the use of one-inch gravel, a consistency that gives a slump of one to three inches and a price of $1.60 per barrel, net, for the cement and $1 per ton for the aggregate. The cost per cubic yard for materials for a 4½-gal. mix is only 69 cents more than for a 6¼-gal. mix. In other words, if the 4½-gal. mix will give the required strength in the required time, parity with the special cement would be reached when the latter would cost only 67÷1.92=35 cents per barrel more than the standard cement. Of course, where calcium chloride is used, this 35-cent difference would be increased by a small amount which may be estimated somewhat as follows: Using 4½ gal. of water and three per cent of calcium chloride at 1¾ cents per pound, we would have: 0.03 x 4.5 x 8.33 x 1.75=20 cents (approximate), making the total extra cost of the 4½-gal. mix about 55 cents more than the 6¼-gal. mix.

Examples

Below is a list of some of the uses of high-early-strength concrete to which it is especially adapted:

1. *In concreting bridge floors.* Following is an example of practice in the use of high-early-strength cement.

Job No. 1—Keele Street Subway, Toronto (Canadian Pacific). This project involved the replacing of a steel and timber deck subway with a heavier steel and concrete deck. The subway

carries six tracks and was replaced in four moves under heavy-traffic conditions, at the throat of a yard. The job was started on September 20, 1928, and completed and turned over to the operating department on November 15, (57 days). A careful study made at the time showed that it would have required 85 days to complete the work if standard portland cement had been used. The work involved the placing of 160 cu. yd. of concrete and the use of 950 bags of the special cement.

The extra cost of this cement over portland cement was estimated at $1,500, but the saving in the cost of curing and protection that would have been required if ordinary cement had been used, and the cost of maintaining traffic and avoiding delays, was estimated to be $3,800, thus showing a saving of $2,300 by using high early strength cement for this work.

2. *In the laying or repairing of pavements* on busy viaducts, railroad crossings, team ways, etc., the quicker resumption of traffic is facilitated.

3. *In the replacement of concrete bearings under turntables.* At busy roundhouses, the turntable is a key point and a saving of hours as well as days is vital.

4. *In the underpinning of concrete abutments.* In one city a large sewer was built recently near an abutment having no pile supports. By the use of a two per cent solution of calcium chloride, a concrete was obtained for underpinning which tested 1,300 lb. in 24 hr. and 2,279 lb. per sq. in. in 48 hr. Even if this or any other concrete of sufficient early strength might be assumed to deteriorate later it would still have served a definite and useful purpose.

5. *In making precast piles* where yard space is limited and a large number of piles are to be made or where the time factor is otherwise important.

6. *In the construction of bridge substructures* where high water might destroy a temporary bridge.

7. *In cold weather construction,* to reduce the time that heating is required and that equipment must be kept in service.

8. *In machinery foundations,* where it is desirable to set the machine up 24 hours after concreting.

9. *In patching freight shed floors* and station and loading platforms.

10. *In ash pits* which cannot be taken out of service for more than 24 hours.

11. *In underpinning masonry* in treacherous ground.

12. *On large jobs* where a reduction in the amount of form lumber might effect economies.

13. *In stopping leaks* through concrete subject to either slow infiltration of water or water under considerable pressure.

14. *For precast blocks* of concrete under secondary bearings.

15. *For column footings* where it is necessary to place the steel soon to avoid delay to steel erection.

No Special Use

From the above it may be seen that the use of high-early-strength concrete is not confined to any special use in railroad construction work, but may be used wherever time and the resulting inconvenience and costly interruption of traffic would offset the greater cost of its proper and careful manufacture.

In conclusion, it must be said that any high-early-strength concrete mixture will produce the best results only when strict attention is given to it during manufacture.

The best materials and equipment may be used, the proportions may be carefully worked out and checked by tests, but if in the hurry of the actual concreting, more water is added, the batches are roughly measured, the time of mixing is cut short, the concrete is poorly placed and then baked out with salamanders in winter or by the glaring heat of the summer sun, the money will be wasted and safety jeopardized.

Committee: L. B. Alexander, (Chairman), assistant bridge engineer, M. C., Detroit, Mich.; Max Baer, concrete inspector, C. & N. W., Chicago; V. S. Brokaw, assistant engineer, C. M. St.P. & P., Chicago; A. I. Gauthier, assistant division engineer, B. & M., Concord, N. H.; Chas. Harrison, Muskogee, Okla.; W. H. Harrison, bridge and building master, C. P. R., Toronto, Ont.; Q. C. Kerns, assistant general bridge inspector, C. & N. W., Chicago; F. M. Misch, bridge department, S. P., San Francisco, Cal.; G. A. Rodman, general supervisor, bridges and buildings, N.Y.N.H. & H., New Haven, Conn.

Discussion

H. I. Benjamin (S.P.) emphasized the necessity of good aggregates and workmanship whether high-early-strength or standard cement is used. In his experience, many admixtures do not increase the strength of concrete. He has found only one, a very finely divided diatomaceous material, which when applied in proper proportions does add materially to the strength of the concrete. He has not found that calcium chloride affects concrete but in several instances the reinforcing bars in concrete to which calcium chloride had been added, were badly corroded. He called attention to a new high-early-strength cement that is being made on the Pacific coast, the chemical composition of which is almost identical with standard cement, but which gives early strengths far in excess of concrete made with standard cement. In certain tests, cylinders have shown as high as 2,000 lb. in 2 hours, 4,000 lb. in 4 hours, 9,000 lb. in 7 days, and in one case 10,381 lb. in 28 days. This particular cement was used in a sea wall in connection with the construction of the Golden Gate bridge, where concrete could be deposited only at low tide, thus giving but 2 hr. and 45 min. working time twice each day. The cement set so rapidly that none of the work done during this limited period was lost. He recommended that roads expecting to use high-early-strength cement, secure samples from manufacturers and make tests so that they can determine the particular kind of cement that may be needed under varying conditions. In this way, when an emergency arises, they will be able to decide without delay, the particular cement best suited to the needs of the particular job.

Warren F. Smith (Lone Star Cement Company) referred to the statement in the report that a reduction in the setting time can be made by doubling the time of mixing. It was his belief that to do this for any considerable volume of concrete would increase the contractor's costs to a greater extent than the additional cost of the high-early-strength cement. He also called attention to the fact that a temperature of 45 deg. will reduce the early strength of concrete made with standard cement by about 80 per cent, whereas, that made with high-early-strength cement is reduced only by about 50 per cent during the same period. He said that there is no better way to obtain high permanent strength in standard cement concrete than to cure it 10 days under moist conditions, but that high-early-strength cement gets the same hydration in two days. He also called attention to the suggestion in the report that greater strengths can be obtained in portland cement concrete by increasing the amount of cement used, but said that where more than six bags were used to obtain a yard of concrete the volume changes increase very rapidly. In response to the query as to the additional cost of high-early-strength cement, he said that the differential in the Chicago market is $0.12½ a bag, as compared with ordinary portland cement.

In response to a question, A. C. Irwin (Portland Cement Association) said that there is no certainty that calcium chloride has ever produced corrosion in reinforc-

ing bars. In this connection he referred to a bulletin of the Bureau of Standards on some very extensive tests made to determine the effect of calcium chloride on concrete and whether corrosion is induced by the use of this material. The conclusion was that it had not been proved that corrosion is thus induced. He said that, theoretically, calcium chloride has an alkaline reaction and that, therefore, it should not have a corrosive effect on iron and steel products, because corrosion is retarded rather than induced by alkaline surroundings. It was his view that corrosion in reinforcing bars can almost always be traced to the position of the bars too near the surface or to disintegration of the surrounding concrete.

In answer to a question from the floor with respect to the relative elastic qualities of concrete made with standard and high-early-strength cements, Mr. Irwin stated that the latter is a comparatively new material which has not been available a sufficient length of time to determine finally all of the relative qualities, but that high-early-strength cement does not differ to any marked degree from standard cement in chemical composition. The principal differences between standard and high-early-strength cements are that the latter is burned longer and ground finer while there are certain differences in the handling and mixing of the raw materials, which are the same for both cements. For these reasons, one cannot logically expect any marked difference in the physical properties of the two.

Mr. Smith said that his company had made a number of investigations to determine whether concrete made from its own high-early-strength cement maintains its strength over a period of years. Cores were drilled in a large number of widely varying structures where both high-early-strength cement and standard cement had been used in construction under substantially the same conditions. In practically every case these samples showed that the high-early-strength concrete had higher strength after 4½ years of service.

Lessons from the Depression

Committee Report

F. E. Weise
Chairman

SINCE our last convention at Louisville, Ky., in 1930, the railroads of this country have been facing a difficult situation—one entirely different from any that have arisen before, mainly because they are confronted by new problems. There is some consolation in the fact, however, that difficult situations that have arisen in the past have been overcome successfully.

As an introduction to this report let us review a statement made by a member of this association in 1895 before a group of men engaged in bridge and building operations on one of the railroads.

It has not always been clear sailing with any of us—difficulties have confronted us, and sometimes our misfortunes have accumulated and seemed so heavy that I do not doubt that many of you have grown weary of existence. For years we have heard the expression "hard times" on all sides, and it has been echoed and re-echoed until we can almost believe ourselves most unfortunate in having our lives cast in the latter part of the nineteenth century. We hear of low rates, bad business, droughts, floods, forest fires, bad politics, disordered labor conditions, etc., until we question if there is anything left which is good. I do not propose to answer such a question further than to express my conviction that the world is good, and to ask you to look at the bright as well as the dark side of things. We are much what we choose to be, happy or unhappy, comfortable or uncomfortable, and an optimist is a far more sensible person than a pessimist.

The foregoing was written by Onward Bates, an honored member of our association, who is still interested in our doings and who was at that time the head of the bridge and building department of the Chicago, Milwaukee & St. Paul. If you were to replace the words "hard times" in his statement with the word "depression" it would not be hard to make any one believe that it had been written within the last few days. Just as surely as the hard times he spoke of passed away, just so surely will the present conditions be rectified.

When this situation first developed it became evident at once that there must be a drastic retrenchment in expenditures. Fortunately, railroad structures had been maintained in first-class condition, thus providing a reserve that proved to be a valuable asset. One of the first problems to be faced was that of economy in the maintenance of structures, and this called for careful study and planning on the part of those directing the work. While most railroads may not have developed any new or novel methods, they have learned to make a dollar go farther than was formerly thought possible. It was found necessary to postpone renewals as long as possible and of course the previous high standard of maintenance could not always be adhered to. Buildings and other structures could not be painted as frequently as formerly and the problem was to decide how long this work could be deferred without detriment to the structure. One of our members puts it this way—"One of the lessons of the depression was to learn how little you can get along with and still keep the structures in serviceable condition."

Perhaps this can be explained better by the statement that the result has been a deeper and more thorough understanding of true economy. Economy is defined as the orderly arrangement and management of the affairs of an industry directly concerned with its maintenance and production, necessitating thrifty and careful administration, management without loss or waste, and retrenchment in expenditures. To fulfill this definition it is necessary to be prudent in expenditures, to utilize materials to the best advantage and to economize in the use of power, labor and time.

Bridge and Building Work Necessary

The bridge and building department is necessarily a spending organization, but it plays an important part in the operation of a railroad. If its work of constructing and maintaining the structures is not carried out properly and efficiently, the other departments will be handicapped in their operations and will not be able to function as they should in taking care of passengers safely and comfortably and in handling and delivering freight properly and expeditiously.

The work of the department must necessarily be largely technical and cannot always be checked as closely as

that of others. Therefore, more responsibility rests with those who plan and direct it. Financial conditions are such that funds can only be obtained for absolute necessities and for that reason some projects that might offer a fair return on the investment in the long run must be deferred or given up.

What Statistics Show

An examination of the reports of the Interstate Commerce Commission for the last five years shows very clearly that much effective planning has been done, as is demonstrated in the tabular statements. The figures speak for themselves. It is also true that the railroad properties could not have been kept in a serviceable condition with such a reduction in maintenance outlay if they had not previously been kept in first-class condition.

Charges to Operating Expenses by Class I Steam Railways for the Five-Year Period

Year	Total Operating Expenses	Amount charged to Maintenance of Way and Structures	Per Cent of M.W. & S. to Total expenses
1929	$4,506,056,262	$855,354,867	18.982
1930	3,930,928,687	705,470,940	17.947
1931	3,223,574,616	530,612,890	16.460
1932	2,403,444,895	351,179,041	14.611
1933	2,249,231,779	322,286,197	14.329

Bridge and Building Charges to Operating Expenses Class I Steam Railways

Year	Bridges, trestles and culverts.	Buildings (station, office, shops, water stations, fuel stations, etc.)
1929	$44,390,306	$92,345,025
1930	37,339,133	72,777,687
1931	27,974,894	48,838,868
1932	19,150,021	28,876,120
1933	17,418,085	28,339,210

The statements sent in by members of this committee were similar in many respects. Special emphasis was laid on the need for careful planning of work so that it can be done with a minimum outlay of labor, materials and equipment. During more prosperous times the attention of supervisory forces was confined largely to improvement or construction work and maintenance was left, in large measure, to the judgment of the bridge and building foremen. Now supervision is centered upon current repairs and maintenance, and more careful planning must be done because of the curtailed forces with which we are now operating.

The Experience of One Road

The movement of crews from one location to another has been carefully checked so that there might be no waste of time. G. L. Sitton, chief engineer maintenance of way and structures of the Southern Railway, made so definite a statement of the manner in which prevailing conditions are being met on that railroad, that it is quoted here because it brings out many conditions that are common to all railroads.

Owing to drastic reductions in the personnel of maintenance forces, we were compelled to develop a method of reducing to a minimum the amount of time lost in moving crews from one location to another. It was found that two or more small forces, rather than one large force, were best adapted to accomplish this. As the force moved along the line it took care of spot painting on structures, miscellaneous station repairs, etc., thus obviating the necessity of sending men back to pick up these items, with a considerable loss of time. The ability to do this was the result of close inspection by the supervisor so that the work was planned in advance. On major repairs, some supervisors stayed on the ground with the force, planning the work and thus permitting the foreman to devote his entire time to direct supervision so that the men were kept busy during the entire working time. We have thus learned from the depression that it is possible to eliminate much lost time.

How to save material has also required much study. This has been accomplished in many ways: By getting the full service life before replacement; by the judicious use of serviceable second-hand material; and by reducing or eliminating entirely the maintenance on those portions of station buildings and platforms that are not essential for the business offered. Probably the largest saving has been obtained through the use of second-hand material, released from main line structures, on branch lines of light-weight traffic and on side-track structures. The policy of brush-coating untreated bridge ties and guard rails with creosote oil has been adopted and gives promise of extending the life of such members materially. On platforms where there is considerable trucking, the planking heretofore laid transversely to the direction of trucking has since been laid longitudinally, thus providing a smoother surface, prolonging the life of the plank and requiring the removal of only those planks that receive the maximum wear. This should have been obvious, but it required a depression to make us see it.

A considerable saving in material has been effected by making minor repairs as small defects developed and not neglecting them until the replacement of the whole unit was necessary. The depression has brought home forcibly the necessity of keeping a well-balanced stock of materials on hand and of anticipating requirements so that the forces will not lose time or be unable to finish a job while on the ground, owing to the lack of materials.

The maintenance of stations and platforms has been reduced or eliminated. We have been keeping the roofs painted but have not painted the remainder of the structures, in spite of the fact that the lack of building painting on the majority of structures is certainly deferred maintenance of questionable economy. This policy, however, has developed the fact that it is possible to over-maintain in this respect for appearance only. We have been forced to determine whether it was necessary to maintain platform facilities or whether changes in the character of traffic handled have made such facilities unnecessary. Thus, many platforms have been eliminated or reduced in size to meet present requirements, thereby effecting a permanent reduction in maintenance expense.

One of the large items in maintenance expense is the cost of work-trains to distribute material. When the work-train appropriation was reduced, we had to use our motor and push cars to a larger extent in distributing material and found it could be done at less expense in that way, and that this practice should be employed to a greater extent in the future. The reduction in the size of gangs has compelled the foremen to rig up hand crabs, etc., for handling the heavier materials, and it developed that, with such aids, the smaller gangs could readily handle about as much material as the larger forces not so equipped and at less expense. This experience has also demonstrated the value of labor-saving equipment and the further fact that, with the exercise of a little ingenuity, it could be applied to many uses other than those for which it was purchased.

The statements made by the committee members and by others who have been consulted show that all railroads have been working along much the same lines. Where permanent structures of good design had been installed and kept in a state of first-class maintenance it was possible to weather the storm with a minimum of expense. In many cases we have been surprised at the low level of expenditures that has sufficed without sacrifice of safety.

Our experiences have, no doubt, disclosed some cases of structures built a number of years ago in which faulty design has made it necessary to spend what seemed an excessive amount for maintenance. These instances, however, have served to point the way to improvement in the design of new structures. Some of the faulty

construction may have been the result of undue haste to get the structure into service supplemented perhaps by lack of careful supervision.

It is not to be expected that the railroads can continue to show the decrease in maintenance expenditures indicated in the figures quoted, because we all understand that we have been drawing on a reserve which eventually will be exhausted, but many valuable lessons have been learned that will be applied in practice with gratifying results. In carrying out his work, the supervisor must keep many things in mind. First of all, he must always consider the safety and welfare of the railroads' patrons and the safety of the working forces. While he plans economy in the use of labor, materials and equipment he must constantly bear in mind that good and conscientious workmanship during the construction period results in economy in maintenance that comes to light as the years go by.

Committee: F. E. Weise (Chairman), chief clerk, C.M.S.P. & P., Chicago; C. A. J. Richards, master carpenter, Pennsylvania, Chicago; A. E. Bechtelheimer, assistant engineer bridges, C. & N.W., Chicago; H. A. Horning, superintendent buildings, M.C., Jackson, Mich.; A. J. James, general foreman bridges and buildings, A.T. & S.Fe., Emporia, Kan.; B. L. Johnson, general master carpenter, G.N., Spokane, Wash.; W. H. Norris, bridge engineer, M.C., Portland, Me.; T. D. Saunders, assistant engineer, C.N., Toronto, Ont.; G. L. Sitton, chief engineer, maintenance of way and structures, Southern, Charlotte, N.C.; J. P. Wood, supervisor bridges and buildings, P.M., Grand Ledge, Mich.

Discussion

Bridge and building officers, according to C. R. Knowles, of the I.C., have been undergoing a process of re-education during the depression, with the result that they now realize that they cannot spend more and more for higher standards to meet demands for future increases in traffic. Traffic will increase again, but the present plant, he declared, will take care of future growth for a long time. The bridge forces, he said, must conduct their work so as to insure safe operation, and that they have done this is shown by the excellent record as to accidents in spite of the reduced expenditures. In his opinion there will be little lessening of the pressure to economize, and officers of bridge work can no longer consider their work in terms of the standards of the past.

In reply to Mr. Knowles, Elmer T. Howson (R.E. & M.) questioned whether economy has not been over-emphasized. We have become accustomed to a "starvation diet," he said, and have come to believe that we can go on indefinitely without an increase in our expenditures. We have been able to "get by" because of the reserve strength plowed into the properties during good times and eventually we are going to use up this reserve strength and will have to restore it. We must not lose sight of the fact that the excellent record of the past four years is not due entirely to improved efficiency. A lot of it amounts simply to postponement of needed work and the day will come eventually when we must put back into the properties the strength that has been taken out of them.

C. M. Burpee (D. & H.) declared that the chief benefit gained from the depression was the movement away from precedent in the conduct of work. The past four or five years, he said, have afforded an excellent opportunity to study specifications for materials, tools and equipment, and such study has revealed the advantage of making substitutions. Another development of studies made on the D. & H. has been the abandonment of 400 buildings which were found to have outlived their usefulness.

H. I. Benjamin (S.P.) expressed the opinion that the railways will never again spend as much money for maintenance as they did prior to 1929. Much unnecessary work was done; appearance was over-emphasized, he said. However, expenditures for restoring exhausted strength will be resumed, and in his opinion replacements will be made in more permanent structures that will make for lower maintenance outlays. J. S. Huntoon (M.C.) said that the depression had shown the way to economy through the greater use of second-hand materials, and cited the cutting up of released stringers into bridge ties. T. B. Turnbull (A.A.) endorsed Mr. Howson's views and said that it is up to the supervisory officer to show his superiors when the limit had been reached in retrenchment. In many cases, he said, much can be gained by taking your superior out over the work to show him the need for repairs, but you must know your facts.

Programming Bridge and Building Maintenance

By G. TORNES

Superintendent of Bridges and Buildings, Chicago, Milwaukee, St. Paul & Pacific, Chicago

DURING the last few years we have been programming our bridge and building maintenance work and scheduling the performance of the field crews. From careful records, it is believed that this activity has brought us some very beneficial results. In this work the term program is used to describe a list of individual projects on which is shown the sequence in which this work is to be carried out during the season. Likewise, the term schedule is used to describe a tabulation which shows the estimated dates on which specific field crews are to start and complete these individual projects.

There is no need for a long discussion of the advantages of programming, scheduling and keeping progress reports to govern the activities of field forces, since it is believed that all are in agreement that the application of some such plan is required if the work is to be done with any sort of efficiency. It is obvious that the supervisor of field activities can handle his forces more efficiently if he has an accurate program and schedule of work prepared and authorized, say on January 1, so that he and his subordinates know definitely the dates on which the individual projects are to be done, and know also that field forces have been provided to carry out this work. It is a great advantage to management to know with reasonable accuracy on January 1, the amount of money that will be required for bridge and building work during the coming year, and how this expense is to be apportioned as to months. Again, by being able to lay down before the purchases and stores departments a complete statement of materials required throughout the year, giving the dates on which deliveries must be made, these departments are in position to make advantageous purchases and an orderly distribution of material. The benefits incident to such an arrangement are readily apparent. For these reasons, this discussion has been restricted principally to the methods involved in the preparation and carrying out of programs.

The first and most important step in the preparation

of both the program and schedule is to have a thorough inspection of all structures made by inspectors who are qualified to determine what repairs will be needed properly to maintain these structures from one working season to the next. The repairs considered necessary are then fully described and written up on special forms, known as work sheets, together with a complete bill of material required for each structure. The importance of careful inspection is emphasized, since it is obvious that a program prepared in this way can be only as accurate as the inspection from which it is prepared.

It is our practice to make the inspection of structures as early in the spring as weather conditions will permit. This inspection is not for the current year, but is for work to be done the following year, that is, inspections made in the spring and summer of 1934 are for repairs to be made during the year of 1935. Obviously, this practice calls for a healthy standard of maintenance. Any thought that, to accomplish this, the structure must be maintained at a standard higher than is economical, is refuted by the actual reduction in maintenance costs enjoyed on our road since the plan has been in effect.

After the work sheets have been compiled, the running repair work must be approved by the general officers. In addition, field surveys must be made and plans must be prepared for structures that require renewal or work of a special nature.

As soon as the program of work to be done during the coming year has been decided upon, a schedule is prepared for carrying out the work. This consists of classifying the work to be done, estimating the man-hours required at each structure, assigning the work to crews properly organized for the particular classes of work, and estimating the dates on which the work on individual structures will be started and completed.

Bridges and Buildings Handled Separately

Because we consider it most economical, bridges and buildings are handled separately, with respect to inspections, schedules and field crews, but the same general plan for programming and scheduling is followed. Work requiring special equipment and for which the average bridge crew working on timber trestles is not equipped to do, such as pile driving, steel bridge repairs, the installation of culvert pipe, and repairs to concrete structures, is assigned to special crews organized and equipped for the particular classes of work involved. Such crews may be worked over several divisions during the season. A typical set-up of bridge and building forces to work over one division for a season is about as follows: Assume a division extending from A to C with B as some intermediate point, the location of which is determined by the volume of work. We schedule a crew of, say a foreman and nine men, to do timber bridge work from A to B, and a similar crew to work from B to C. Each of these crews will do the work progressively in the order in which it is reached, avoiding back traveling as much as possible. Material will be unloaded out of face over the route, covering about 60 days' requirements in advance of the work. It is also likely that we will have two crews assigned to building repair work, each consisting of a foreman and four or five carpenters, working in a similar manner with respect to material and progress.

In addition, a system pile-driving crew will be scheduled to work over the division, the dates of arrival and departure being set to insure that the pile driving will be completed in advance of the arrival of the timber crew at all bridges. It is also likely that a special system crew will be scheduled to work over the division placing culvert pipe, particularly if a number of trestles are to be replaced in this manner. A steel gang and probably a crew equipped to make repairs to concrete structures will be scheduled to work over the division in conjunction with the system program. The dates of the arrival of and departure from the individual jobs are estimated, and all concerned are advised of these dates.

All bridge and building forces work under the jurisdiction of the division supervisors while on the respective divisions. The division officers are not permitted to change the work schedules of the crews, however, except in an emergency which requires immediate use of the forces for the continuance of traffic or on the authority of the general office. This rigid adherence to the scheduled work is insisted on to prevent the indiscriminate moving and disorganization of forces for unimportant repairs, which would mean loss of time in moving and a reduction in the per man-day output of work. We have found that the longer the system is in effect the fewer are the requests from division officers for permission to depart from the schedule.

After the programs and schedules are prepared for every division on the system, requisitions are forwarded to the purchases and store departments for all materials required during the season, delivery dates being shown on these orders. Information as to the order in which material is to be unloaded is also furnished. This is to avoid the difficulty experienced when it is found that the first timber wanted is at the bottom of the carload.

From the complete schedules we also prepare an expenditure report. This includes an estimate of the money to be spent during the year and the retirements to be made, divided into the various accounts and by months. This report is of value to the general officers, enabling them to anticipate the need for the money required to carry on the bridge and building work. It is our aim to have all schedules and accompanying details completed and in readiness for the season's work on January 1 of each year.

For the purpose of following up the location of the various crews and their progress, and for cost keeping, a monthly progress report is made by each division. To simplify the work involved in making the estimates, man-hour factors for various units of material are applied. The progress report shows the actual man-hour factors developed by each gang on each job as the crews perform their work. The application of these factors provides a convenient means for checking the efficiency of each crew. The factors have been developed through several years of cost keeping on the performance of our average good crews. It has been found that the average good crew can meet the scheduled dates by doing an honest day's work and without unpleasant driving on the part of their supervisors.

Our records show that the application of this plan has resulted in an increased output of work per dollar spent in labor, sufficient to effect a payroll reduction of slightly more than one million dollars annually. It is our conviction that our company will continue to save this million dollars yearly so long as the bridge and building work is programmed and scheduled, provided these programs continue to be prepared accurately and a sincere effort is made to carry them out.

Discussion

In answer to a question from the floor, the speaker stated that good foremen complete their work in accordance with the schedule provided. In a few cases poor foremen have been unable to keep up with the schedule, but in general, the schedule is carried out as

prepared. H. I. Benjamin (S.P.) questioned whether it is possible to carry out such a schedule year after year, because after the schedule has been prepared it is often decided to hold work over for another year. He had known instances where as much as 30 to 40 per cent of an annual program had been carried over to the following year.

In answer to another question the speaker replied that on the Milwaukee, the scheduling of bridge and building work had not been seriously affected by the depression. Owing to the extremely large savings that have been demonstrated by the plan, the managing officers have been inclined to permit the work to go through as scheduled. In a few cases, conditions have arisen after the schedule has been prepared which made it desirable either to omit certain items or to do more work than had been contemplated originally. However, these few exceptions have not affected the programming as a whole. T. B. Turnbull (Ann Arbor) said that he had followed the practice of programming his work during the last five years, but that he had never been able to carry out the schedule completely. In the effort to do so, however, he had saved a large amount of money as compared with the older practice of doing the work without a program. In other words, he had not been able to clean up his work progressively as is done on the Milwaukee, because he had been required to move to certain jobs that required immediate attention. On the other hand, working under the schedule and to disadvantage, he had been able to do all the work that had been programmed each year. H. H. Best (M.P.) very definitely favored the practice of programming work. In his view, this is so important a feature in economy that he predicted that within a few years every road in the country will be tending toward a plan similar, if not a duplicate, of that now in effect on the Milwaukee.

Relative Advantages of Separate as Against Combined Gangs for B & B Work

Abstract of Committee Report*

H. C. Munson
Chairman

IN an effort to determine the relative advantages of organizing gangs to handle both bridge work and building work or of providing separate gangs for each class of work, the committee made inquiries concerning the practices of 30 railroads, exclusive of the 10 represented by the committee. So widely at variance were the opinions submitted that it was found impossible to set forth any hard and fast rules in favor of one type of gang or the other. Therefore, it was decided to present the advantages and disadvantages of each type of organization, leaving it to each maintenance officer to choose that type of gang that best suits his requirements.

Advantages ascribed to the combined gang were that it cleans up all work as it progresses; it saves traveling time of the gangs; it tends to develop more capable foremen, the contention being that foremen should not be specialists; it calls for less fluctuation of seasonal labor requirements; it promotes individual responsibility and pride among the foreman and his men; and it tends to promote better morale among the men who are able to visit their home more frequently. Further, under this plan the men become more familiar with the characteristics and needs of their particular territories.

On the other hand, the combined gang cannot attain a high degree of efficiency because it is often necessary for the men to perform tasks with which they are not familiar. Furthermore, owing to the difficulty of making a comparison between gangs on a man-hour or other unit basis, this important incentive for increased performance is lacking with this type of gang. The same characteristic makes the programming of work difficult. Loss of time results during the reorganization of gangs for different jobs and the hazard of personal injury is increased.

Generally speaking, the above considerations comprise conversely a statement of the advantages and disadvantages of the separate gang. In addition, such gangs are said to require fewer units of expensive equipment, which is, moreover, in more continuous service. Furthermore, the separate gang affords opportunities to economize in the handling and disbursement of material.

At this point the report described how the Chicago, Milwaukee, St. Paul & Pacific has effected large economies in the conduct of bridge maintenance by using highly specialized (separate) gangs operating according to a carefully developed program or schedule.

Committee: H. C. Munson (chairman), trainmaster, C.M. St.P. & P., Dubuque, Iowa; K. Peabody (vice-chairman), deceased, general supervisor bridges and buildings, N.Y.C., New York; J. Ferguson, division engineer, C. N. R., London, Ont.; A. N. Reece, chief engineer, K.C.S., Kansas City, Mo.; S. C. Tanner, superintendent roadway shops, B. & O., Martinsburg, W. Va.; T. B. Turnbull, superintendent bridges and buildings and interlockers, Ann Arbor, Owosso, Mich.; L. A. Warren, supervisor bridges and buildings, S. P., Sacramento, Cal.; J. J. Wishart, bridge and building supervisor, N.Y.N.H. & H., Boston, Mass.; J. P. Yates, assistant supervisor bridges and buildings, Gulf Coast Lines, De Quincy, La.

Discussion

E. C. Neville, (C.N.R.), said that owing to the decrease in the amount of work done, gangs on his road were now consolidated to do all classes of work except such special tasks as the under-pinning or pointing of masonry, or heavy steel repair work. Before the depression, he said, it was customary to organize a pile driver gang to operate over four or five divisions, but this plan has now been abandoned. J. P. Wood, (P.M.), said that he had used both the separate and combined gangs and based on this experience, he is convinced that the most economical results can be obtained with a carpenter gang that is organized to do all classes of work. However, he pointed out that the key to success with the combined gang lies in the selection of the foreman, since many men

*This report was published in full in the January, 1932, issue of *Railway Engineering and Maintenance*, page 37.

who can direct work on bridges with excellent results, are not qualified to handle work on buildings, or vice-versa. It is up to the supervisor, he declared, to be on the lookout for men who can be trained as foremen in both classes of work. He also recited some experiences to point out the excessive cost of attempting to segregate the two classes of work and assign them to separate gangs.

T. B. Turnbull, (A.A.), disagreed with Mr. Wood, stating that he had also used both types of organizations, but is convinced that more efficient results will be obtained with separate gangs. In his opinion it is not solely a question of the foreman, but of the qualifications of the men in the gangs to do both classes of work, and insisted that workmen cannot be transferred from heavy bridge work on one day to repairs on the trim of a station building on the next and expect them to turn out good work. Mr. Turnbull's position was endorsed by C. W. Wright, (L.I.), and C. F. Weir, (P.M.).

Mr. Wood replied that it costs more to supervise the work of separate gangs, and called attention to the fact that times have changed and that the supervisory officers must adjust their views to meet the needs of the present, regardless of their experiences in earlier years. Mr. Neville expressed his approval of Mr. Wood's position, and agreed that present conditions compel the organization of gangs to do all classes of carpenter work. However, in answer to Mr. Wood, Chairman Munson declared that he was in the possession of figures demonstrating that separate gangs can do work more economically than combined gangs.

The Maintenance of Ballast-Deck Trestles

Abstract of Committee Report*

H. I. Benjamin
Chairman

FOLLOWING a brief discussion of the place of the ballast-deck trestle in railroad construction practice, this report dealt briefly with the necessity of taking measures to avoid damaging the treatment which preserves the wood, and outlined various precautions that are in current use. Stress was laid on the importance of periodic inspections by the foremen, the supervisors and system officers in maintaining a record of the condition of structures.

The bulk of the report was devoted to outlining in detail accepted methods of (1) replacing individual piles, (2) replacing entire bents, (3) replacing caps, and (4) renewing stringers. In carrying out such repairs, trestles may be divided into two groups as follows:

1. Those structures over waterways, which, except during storms or exceptional periods of rainfall, are dry and where the ground line is 15 ft. or less below the bottom of the deck.
2. Those which are high or are continuously over water.

The first group calls for comparatively simple methods of renewals, as in most cases the work may be carried on from the ground, while repairs made to structures in the second group require staging and, in most cases, a larger gang as the work must be carried on from the deck of the structure.

The report gives detailed instructions, together with drawings, for the construction of staging to be used in renewing caps on structures in Group 2. It was also accompanied by a drawing showing a form of staging to be used in the renewal of individual stringers. A complete list of the tools needed in making repairs to ballast-deck trestles is given and a few labor cost records are cited.

The report closed with the following remarks:

In conclusion the committee desires to stress the matter of safety in carrying out this work. The timbers used are heavy and the staging must be safe to carry not only the men working on it, but also the heavy timbers. The foreman should see personally that all timbers used in the staging are in good shape and should test and inspect them periodically. No staging should be suspended by a manila rope of less than 1¼ in. diameter or its equivalent, and it should be so secured as to prevent it from slipping or chafing. Jacks should be tied in such a manner that they cannot "kick out." Hand railings should always be installed. Platforms should not be less than 30 in. wide and all fastenings must be securely made. Cleats should be used to prevent any timbers from slipping off their supports.

Committee: H. I. Benjamin (chairman), vice-chairman, committee on insurance, S. P. Sys., San Francisco, Cal.; T. H. Strate (vice-chairman), division engineer, C.M.St.P. & P., Chicago; C. W. Boyce, supervisor bridges and buildings, I. C., Vicksburg, Miss.; L. G. Byrd, supervisor bridges and buildings, M. P., Poplar Bluff, Mo.; J. L. Duncan, assistant supervisor bridges and buildings, M-K-T., Denison, Tex.; W. C. Harman, supervisor bridges and buildings, S. P., San Francisco, Cal.; W. V. Parker, bridge and building foreman, St. L. S. W., Paragould, Ark.; Arthur Sweet, bridge and building foreman, A. T. & S. F., Newton, Kan.; B. M. Whitehouse, general bridge inspector, C. & N. W., Chicago; G. W. Young, master carpenter, B. & O., Washington, Ind.

Discussion

J. F. Seiler, (field engineer, Service Bureau, American Wood Preservers' Association), said that in the final analysis the cost of maintaining structures of this type must be determined in order to compare their economy with other types of construction. Based on a careful investigation of cost for creosoted ballast deck trestles, made by the Atchison, Topeka & Santa Fe, he estimated that this road could get 45 years of life from this type of construction, and that it would be possible to exceed this if the roads were willing to pay the increasing cost of maintenance during the period of additional life. The structures involved in this investigation were all on one line, and at the time the estimate was made, ranged from 20 to 32 years of service life. Up to the time of the investigation, maintenance had cost $0.22 per lineal foot per year, or, 0.49 per cent of the original cost, which averaged $45 per running foot. Similarly, from figures presented by the Illinois Central in connection with the Bonnet Carre spillway, maintenance costs had been $0.27 per year for 25 years, or, 0.6 per cent of the original cost of the structures. These figures were based on 182 structures, ranging from 15 to 25 years old. Extending the curve representing the sinking fund charges and the curve representing maintenance, it was determined that the low point in the cost per year will fall at about 35 years, after which the structures can be carried on maintenance charges alone

*This report was published in full in the February, 1932, issue of *Railway Engineering and Maintenance*, page 97.

during the remainder of their life, since amortization should be completed in 35 years. According to Chairman Benjamin, the Southern Pacific finds that, in general, repairs to creosoted ballast deck trestles during the first 15 years are confined to the planking under the ballast. J. S. Huntoon, (M. C.), stated that on his road there are two creosoted ballast deck trestles, each 100 ft. long, which are 24 years old, upon which no maintenance has yet been required. A recent inspection indicated that it will be at least 10 years longer before maintenance work will be necessary.

A. B. Scowden, (B. & O.), stated that while little trouble is experienced with respect to failure of bridge timbers, in his experience, there are more or less failures in piles through decay immediately below the zone of treated wood. In reply to his inquiry as to the reason for this, Mr. Seiler stated that trouble of this character is generally due to incipient decay before the piles are treated. He said that in some cases sufficient infection will occur within 30 to 60 days after the pile is cut to cause this trouble after treatment, but that since this had been discovered it has been overcome by steaming the piles for at least 6 hours before they are treated. With this period of steaming, the temperature of the wood is raised to a point where the infection is killed. Mr. Benjamin called attention to the fact that another point of serious decay is at the top of the pile where it is cut off, and that this emphasizes the need of unusual care in providing protection against the entrance of decay-producing organisms at this point. E. C. Neville, (C.N.R.), reported that the penetration of the preservative is not always uniform and that in some cases this has an influence on the genesis of decay. Mr. Benjamin then stressed the desirability of making certain that proper treatment is given to the piles, and cited an example of long service of piling taken from certain Southern Pacific structures in San Francisco bay. Two years ago, the Benecia slips were dismantled after the construction of the steel bridge at that point. These piles had been in service for 22 years. Upon removal they were found to be in such good condition that they were retreated with creosote and used in a number of less important structures. Piles taken from the dismantled Long Wharf 20 years ago were reused after 35 years of original service and are still in good condition today, after a total of 55 years' service.

The discussion then turned on the value of preframing timber to be treated, and the danger of framing timber after treatment was particularly stressed by several speakers. Some question was raised as to the possibility of complete preframing. H. H. Best (M. P.), stated that while some preframing had been done earlier, the Missouri Pacific started to preframe all bridge material at the Little Rock plant two years ago, and by the end of this year more than 4,000,000 ft. b. m. of preframed timber will have been treated. This includes the boring of all bolt holes, except in brace planking intended for use on pile bents.

Relative Merits of Inside Metal and Outside Wooden Guard Rails

Abstract of Committee Report*

C. A. J. Richards
Chairman

CONSIDERATION of the merits of inside metal guard rails and outside timber guard rails is so closely related to a consideration of bridge decks as a whole that the committee determined upon the use of a questionnaire as a means of developing the trend of current practice and opinion, and much of the report is based on information obtained from replies to the questionnaire. Inside and outside guard rails, it was explained, perform separate and distinct functions. The function of the inside guard rail is to keep the lateral displacement of derailed equipment within limits that will minimize the opportunity for serious damage to the track or the structure, while the function of the outside guard rail is to insure the normal spacing of the ties, and prevent bunching of the ties in the event of a derailment. Recommended practices covering the use of guard rails on wooden bridges and trestles were quoted from the Manual of the American Railway Engineering Association for 1929.

The balance of the report consisted of a discussion of the replies to the questionnaire. That part of the replies concerning inside guard rails was dealt with under the following headings: (1) Open-Floor Bridges; (2) Ballasted Decks; (3) Through-Floor Bridges; (4) Timber Bridges; and (5) Special Types. Replies to the questionnaire concerning the use of outside guard rails were treated at length under the general heading and also under the headings: Special Types; and Tie Spacers.

Appended to the report was the following summary:

It is apparent from the information furnished that: (1) Both inside guard rails and outside guard rails are in general use; and (2) T-rails for inside guard rails and timbers with or without daps for outside guard rails are generally preferred.

The committee considers it advisable to use T-rails of the same or slightly less height than the running rails, spaced about 9 in. from the running rails with or without rail braces and brought together at a point beyond the ends of the bridge. The outside guard rails should be spaced 18 in. from the gage side of the running rails, unless the detail of deck anchorage to the superstructure makes this impracticable. If not dapped, the timbers may be 4 in. by 8 in. or 5 in. by 8 in. in section, laid flatwise, and fastened to each tie with lag screws. Where some form of tie spacer is used between the ties, the lag screws may be more widely spaced. If dapped, the timbers may be 6 in. by 8 in. laid flatwise, with daps 1 in. to 2 in. deep, and fastened to each tie with bolts or lag screws. Since the outside guard rails may prevent serious damage in case of derailment, it does not seem desirable to eliminate them. Rather, it appears desirable to increase their effectiveness by reinforcing them with tie spacers.

Committee: C. A. J. Richards (chairman), master carpenter, Penna., Chicago; E. E. R. Tratman, Wheaton, Ill.; A. E. Bechtelheimer, assistant engineer bridges, C. & N. W., Chicago; Thomas E. O'Brien, bridge and building master, D. & H., Car-

*This report was published in full in the April, 1932, issue of *Railway Engineering and Maintenance*, page 267.

bondale, Pa.; J. S. Huntoon, assistant bridge engineer, M. C., Detroit, Mich.; B. R. Meyers, assistant general bridge inspector, C. & N. W., Chicago; A. B. Scowden, general bridge inspector, B. & O., Cincinnati, Ohio; H. C. Swartz, superintendent bridges and buildings, C. N. R., Montreal, Que.; R. C. Young, chief engineer, Lake Superior & Ishpeming, Marquette, Mich.

Discussion

C. M. Burpee, (D. & H.), reported the practice of his road in the use of creosoted guard timbers that were dapped before treatment. He said that this practice had proved entirely satisfactory on spans up to about 40 ft. in length, but that some difficulty had been experienced in obtaining a good fit on longer structures, especially in cases where additional cover plates had been added to top flanges. For this reason, the D. & H. has abandoned dapping of guard timbers and is now depending on bolts and lag screws, but he is of the opinion that tie spacers should be used.

H. I. Benjamin, (S.P.), described the use of 90-lb. rail for inside guard rails in which angle bars and bolts are eliminated by welding the rails in units of three-lengths and applying fish plates welded in place at the ends of these three-rail units in such manner as to provide a slip joint. This was done he said, to eliminate the obstructions introduced by the presence of angle bars on the guard rails. It is the practice on his road, he continued, to omit inside guard rails on bridges less than 150 ft. in length, on the ground that it is no more necessary to provide them on such short bridges than it is in regular track supported on roadbed.

In reply to Mr. Burpee, A. B. Scowden, (B. & O.), stated that his road had experienced no difficulty in pre-framing dapped guard rails for bridges of any length.

Comparative Cost, Durability and Protective Value of Brush and Spray Painting

Abstract of Committee Report*

C. Miles Burpee
Chairman

THE information making up the substance of this report was received in answer to a questionnaire, replies being received from 34 railroads having a total mileage of 107,052. Comprehensive information was given concerning the extent to which the spray painting method is used; the types of compressors and mountings in general use; factors to be considered in the application of this method to steel bridges and metal surfaces; cost figures; and the durability and protective value of paint applied by spray guns.

The following summary and recommendations were given in the conclusions of the report.

As a result of the investigation and study by the committee, it is apparent that:

1. Modern spray painting machines and their accessories have been developed to such a degree that types are now available for the proper application of practically all types and weights of paints adapted to the upkeep painting of all railway buildings, bridges and structures.

2. In practically all instances the rate of application by machines is much greater than the rate of hand brush painting. Labor costs of application have been materially reduced by the use of spray equipment.

3. The loss of material from atomization, even in exposed locations, is trifling. In many instances the mechanical painting of bridges and steel structures has required less paint than brush methods. Experienced craftsmanship and proper equipment for the spray painting of buildings have reduced the consumption of paint to less than six per cent in excess of that used in brush work on similar surfaces. Other instances are recorded where similar exterior surfaces have been painted with similar quantities of the same paint by both methods. Many instances have been noted where one spray coat covered as well as two brush coats on interior work.

4. The finished appearance of spray painting is equal to and in many instances surpasses the appearance of brush work.

5. The use of suitable spray-painting equipment operated by experienced craftsmen results in the application of a more even, denser and glossier film than that produced by brush methods. Such a film is believed to be more resistant to the elements and of more protective value. The durability of sprayed films is at least equal to and in some instances surpasses that of films that have been applied by hand.

6. The cost of painting buildings, bridges, and other structures is recommended as of practicable, economic and commercial value to the railroads of this continent.

Committee: C. Miles Burpee (chairman), research engineer, D. & H., Albany, N.Y.; J. E. King (vice-chairman), deceased, engineer maintenance of way, C. & O., Richmond, Va.; E. E. Candee, supervisor bridges and buildings, N.Y.N.H. & N., New Haven, Conn.; H. Cunniff, general foreman painters, D. & H., Cohoes, N.Y.; L. D. Garis, assistant general bridge inspector, C. & N.W., Chicago; E. C. Neville, bridge and building master, C.N.R., Toronto, Ont.; C. U. Smith, harbor terminal director, Milwaukee, Wis.; C. D. Turley, assistant engineer, I.C., Chicago; H. H. Ueckert, supervisor stores, S. P., Houston, Tex., D. K. Van Ingen, supervisor bridges and buildings, C. & N.W., Mason City, Iowa.

Discussion

A. B. Scowden, (B. & O.), emphasized the need for a thorough cleaning of steel surfaces, regardless of the method of paint application. In his experience, hand cleaning is most costly, sand blasting is slightly less expensive, and cleaning with pneumatic chippers and rotary brushes can be done at least cost. J. P. Wood, (P.M.), said that both the supervisor and foreman should use judgment in deciding which method of application should be followed, because on large jobs it may be cheaper to apply with a spray gun, while on small jobs, the cost of moving the equipment to the site of the work may be great enough to make this method more expensive. Furthermore, even on large jobs some parts of the structure can often be painted more readily with brushes, especially lattice bars and small members, because so much of the paint spray is lost when it is applied to small sections. He recommended the use of spray guns for cleaning dirt from ceiled surfaces in buildings, saying that this is the most effective way to blow dirt out of the crevices between boards. For cleaning steel

*This report was published in full in the December, 1931, issue of *Railway Engineering and Maintenance*, page 1044.

bridges he finds that pneumatic chisels and chippers, and circular wire brushes are not only cheaper, but that more thorough cleaning can be done with them.

J. S. Huntoon, (M.C.), called attention to certain penetrating oils now on the market that will loosen scale and make cleaning very much easier and less expensive. He stated that in recent tests on two structures it was found that the cost of cleaning the structures to which the oil had been applied, was only about half of that for the structures to which no application had been made. It is important, however, that the oil be applied several months prior to cleaning to give ample time for loosening of the scale. He also said that the oil which he has been using does not affect either the old or the new paint.

E. C. Neville, (C.N.R.), advocated the use of sand blasting as the best and cheapest method of cleaning. He said that the spray painting has been done on his road for about 7 or 8 years and that careful records indicated that it is the most economical method for painting both bridges and buildings. He suggested that the time has come for the development of some type of material other than paint for protecting steel surfaces, because of the short life of paint and the resultant high cost over a period of years. He gave as an example of recent developments along this line, a structure recently coated with atomized zinc. In making the application the entire structure was sand blasted and the zinc was applied as a spray of molten metal. The cost of the application was about three times that of paint, but accelerated tests indicated a lower total cost, because of the longer life of this form of protection. H. I. Benjamin, (S.P.), doubted the advisability of using the spray method where high winds prevail, owing to the large amounts of paint that are lost during the painting operation.

The Bridge and Building Supply Exhibit

ONE of the features of the meeting was the exhibit of materials and equipment presented by the Bridge and Building Supply Men's Association. This exhibit was of special interest to those attending the convention, since many new developments were on display, and they took full advantage of the opportunity to become familiar with equipment and materials which they had not heretofore been able to study at first hand. The number of exhibitors presenting displays of their products this year was 34.

The officers of the Bridge and Building Supply Men's Association, who were responsible for the preparation and conduct of the exhibit were: President, S. A. Baber, High Grade Manufacturing Company, Cleveland, Ohio; vice-president, B. S. Spaulding, Fairbanks, Morse & Co., Chicago; treasurer, B. J. Wilson, The Pocket List of Railroad Officials, Chicago; secretary, J. W. Shoop, the Lehon Company, Chicago; members of the Executive Committee, L. F. Flanagan, Detroit Graphite Company, Chicago; K. T. Batchelder, Insulite Company, Chicago; J. H. Bracken, The Celotex Company, Chicago; C. H. Johnson, Fairmont Railway Motors, Inc., Fairmont, Minn.; A. J. Filkins, Paul Dickinson, Inc., Chicago; honorary director, I. B. Tanner, The Tanner-Willard Company, St. Louis, Mo.

In the election of officers, Mr. Spaulding was advanced to president, Mr. Shoop was elected vice-president, Mr. Wilson was re-elected treasurer, and Mr. Flanagan was elected secretary. T. G. Windes, National Aluminate Corporation, Chicago, and G. R. McVay, Ruberoid Company, Chicago, were elected as the new members of the Executive committee.

List of Exhibitors

Barrett Company, New York; C. M. Timpe and W. F. Doriot.

Binks Manufacturing Company, Chicago; paint spray equipment; J. E. Schabo.

Celotex Company, Chicago; literature and samples of wallboard, hard tile and insulation; D. J. Carmouche, H. A. Winandy and C. W. Young.

Cole Automatic Nutlock Corporation, Elwood, Ind.; nut locks; V. G. Cole and C. H. Prager.

Dearborn Chemical Company, Chicago; sample of rust preventives; E. M. Converse, A. C. Mueller and C. C. Rausch.

Detroit Graphite Company, Detroit, Mich.; literature on rust prevention and paints, and samples of paint colors; Luke F. Flanagan and J. R. C. Hintz.

De Vilbiss Company, Toledo, Ohio; spray painting equipment; George R. Cooke.

Paul Dickinson, Inc., Chicago; smoke jacks, cast iron chimneys, drain heads and ventilators; A. J. Filkins.

Joseph Dixon Crucible Company, Jersey City, N. J.; paints, graphites and graphite products; E. C. Bleam.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.; ratchet and screw bridge jacks; C. N. Thulin and E. E. Thulin.

Fairbanks, Morse & Company, Chicago; catalogs on pumps, turbines, Diesel engines, standpipes, electric motors and motor cars; E. C. Golloday, E. F. Kultchar, W. L. Nies, B. S. Spaulding and C. H. Wilson.

Fairmont Railway Motors, Inc., Fairmont, Minn.; literature on motor cars and work equipment; C. P. Benning, Kenneth Cavins, Arthur Fletcher and C. H. Johnson.

Federal-American Cement Tile Company, Chicago; samples of concrete roof slabs and literature on concrete cribbing; C. Hahn and A. Isherwood.

Hastings Signal and Equipment Company, Boston, Mass.; clearance warnings; R. W. Hastings and Barton Snow.

High Grade Manufacturing Company, Cleveland, Ohio; roofing cement, calking and glazing compound, and roof renewing compound; S. A. Baber.

Ingersoll-Rand Company, New York; pneumatic tools; R. W. Bailey, G. W. Morrow and D. W. Zimmerman.

Ingot Iron Railway Products Company, Middletown, Ohio; samples of multi-plate pipe and paved invert pipe, literature; E. T. Cross, W. R. Greenawalt and J. L. Young.

Insulite Company, Minneapolis, Minn,; literature and samples of insulation; K. T. Batchelder, O. R. LeVene and John Shonts.

Johns-Manville Sales Corporation, New York; literature and samples of asbestos board, asbestos roll roofing, asbestos bridge plank, built-up roofing, and waterproofing; C. S. Klingman and T. O'Leary, Jr.

Kaustine Company, Inc., The, Libertyville, Ill.; literature on sanitary facilities; Charles Smale.

Lehon Company, Chicago; samples of liquid asphalt and roofing; Tom Lehon and J. W. Shoop.

Earle A. Mann & Associates, Chicago; stream-line pipe and fittings, copper pipe and fittings, valves and paint spray equipment; Earle A. Mann, A. A. Walker and W. F. Weber.

Massey Concrete Products Corporation, Chicago; literature and photographs of concrete highway crossings, culvert pipe and cribbing; Ross Clarke and D. A. Hultgren.

National Aluminate Corporation, Chicago; sodium aluminate, chemical balls, proportioners, and water-treating equipment; P. W. Evans, J. L. Gibboney and T. G. Windes.

National Lead Company, New York; structural paints and anchoring specialties; W. S. Carlisle and Otto Meyer.

George P. Nichols & Bro. Inc., Chicago; photographs of turntable tractors; S. F. Nichols and B. F. Goldman.

Otley Paint Manufacturing Company, Chicago; samples of pigments; E. Van Patten and W. A. Otley.

W. W. Patterson Company, Pittsburgh, Pa.; wood and steel tackle blocks; W. W. Patterson.

Patterson-Sargent Company, Cleveland, Ohio; paints; Geo. W. Anderson and W. H. McBride.

Pittsburgh Plate Glass Company, Newark, N. J.; paints and water-proofing; F. A. Derfuss, J. G. Mowry and L. F. Theurer.

Pocket List of Railroad Officials, New York; copies of publication; B. J. Wilson.

Railway Engineering and Maintenance, Chicago; copies of publication; E. T. Howson, W. S. Lacher, H. A. Morrison, G. E. Boyd, C. J. Wageman and H. E. McCandless.

Ruberoid Company, New York; asbestos tiling, shingles and roofing; T. N. Dantz and G. R. McVay.

U. S. Wind Engine & Pump Company, Batavia, Ill.; samples of float valves, and literature on tank fixtures and water columns; C. E. Ward.

What's the Answer?

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions that you may wish to have discussed.

To Be Answered in January

1. *What is the purpose of a flanger? When should it be operated? What are its limitations?*

2. *What means can be employed to eliminate or minimize the effect of anchor ice at intakes during extremely cold weather?*

3. *When gaging track where cross-ribbed tie plates are installed, what measures are necessary to prevent the ribs from slipping back into the old grooves?*

4. *What effect does extreme cold weather have on the paint film on steel surfaces? On wood surfaces? What can be done to overcome the trouble?*

5. *Should rail that has been burned by slipping drivers be removed from the track? Why? If not, can the surface be restored by welding?*

6. *To what extent can building hardware be standardized? What are the advantages? The disadvantages?*

7. *Where thick shims are used, what methods should be employed in bracing the rail?*

8. *Where drift bolts cannot be pulled from stringers or caps by means of claw bars, what alternate method should be employed? What tools are required?*

Ties in Sidings

Is a lower standard of tie inspection warranted for passing sidings and other side tracks than for main tracks? If so, how should this standard compare with that for main tracks?

Difficult to Standardize Tie Inspection

By A. N. REECE

Chief Engineer, Kansas City Southern, Kansas City, Mo.

The condition of ties in all tracks should be such as to meet the service requirements in those tracks. Consideration must be given to the weight of the rail, whether tie plates are installed, the amount of ballast, the condition of the roadbed, the weight of the power operated over the track and the importance of the movements that are made.

Generally, a somewhat lower standard for tie conditions is permissible on passing and other side tracks than on main tracks, because movements over these secondary tracks are made at low speed. Like many other problems confronting maintenance officers, however, it is extremely difficult to standardize inspection requirements for passing and other side tracks, owing to the widely varying conditions which surround them.

Many Factors Must Be Considered

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

There are so many factors to take into account, including the weight and condition of the rail, the presence or absence of tie plates, the kind and amount of ballast, the character of the roadbed, the character and volume of traffic and the speed at which trains are operated, that this question must be answered in general rather than specific terms. In the past, there was a general tendency to neglect sidings until complete overhauling became necessary and the track was then expected to run without much attention until it needed another overhauling. Even today this tendency has not been entirely eliminated, despite better maintenance practices.

In some cases, operating methods have been so developed that trains meet on lap sidings without either train stopping. In such tracks, the same standards of tie inspection should prevail as for main tracks. On the other hand, movements through the great majority of passing and other side tracks are made at low speed, so that there is little necessity for as rigid an inspection of the ties as safety and smooth riding require for main tracks.

In recent years, incident to the general improvement of the physical properties, heavier and better rail has been applied to practically all passing sidings and to many other side tracks. Usually the tie plates released with the rail are also re-applied. Along with this, larger and better ties, many of them treated, have been inserted, until one seldom sees the small pole ties that were so common in sidings only a few years ago. It has been recognized also that clean ballast of proper depth is economical for sidings as well as main tracks. These improvements have all tended to increase the life of the ties, so that now one seldom sees the deplorable tie conditions of other days.

Taking all of these factors into account, and considering that tie plates tend to hold the track to gage, even on inferior ties, it is my belief that one can safely fix a lower standard for the inspection of ties in sidings than for main tracks, except in the few cases where high speeds are maintained. It should be understood, however, that when a tie has failed, through decay, breakage or other cause, so that it no longer supports the rail, it should come out in any event.

Standard Can Be Lower

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

Inspection standards for ties in sidings can safely be less rigid than for those in main tracks. Neither the speed nor the volume of traffic through sidings is as great as on the main track, so that the same requirements for safety do not apply to the siding that must be considered for main tracks. As long as a tie is able to support the rail and hold gage it can be allowed to remain in a siding, while a rail-cut or plate-cut tie that

would not be allowed in any main track may be suitable for several years' service in passing or other side tracks. This does not mean that failed ties should be allowed to remain in a siding any more than in a main track but it does mean that safe and satisfactory conditions can be maintained in sidings with the ties in a poorer condition than would be permissible under high speeds. This being so, there is no economy in applying the same rigid requirements to both classes of track.

Standard Should Be the Same

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

A standard of tie inspection lower than that employed for main tracks is not warranted for passing and other sidings. Ties in these tracks should receive the same careful inspection as those in the main tracks. On the other hand, the ties used in sidings may be of lower quality than main-track ties. In not a few instances, ties are removed from main tracks because their service life in these tracks is exhausted, although they might last several years more if inserted in a siding, because of the lower speed and lighter traffic.

When inspecting other than main tracks, one must consider that the same locomotives and cars use both. If the main track along a siding is blocked, it is not uncommon to route trains through the siding until the line is opened, and although the speed may be low, the track must be in condition to carry the traffic safely.

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Maintaining Railway Crossings

What details should be given special attention in maintaining railway crossings? What is their relative importance?

Drainage, Ballast and Timber Are Important

By THOMAS E. MacMANNIS

Supervisor of Tracks, Central of New Jersey, Somerville, N. J.

In the maintenance of railway crossings the same attention should be given to details of track construction that are necessary elsewhere. Most important of these are good drainage, clean ballast of ample depth and sound timbers, since without these no methods of maintenance can be expected to produce satisfactory results. Assuming, therefore, that these basic requirements have been met, particular attention should be given to maintaining the running surface over the crossing; to the gage of the track through the crossing and to the guard-face gage; to holding correct line; and to keeping the bolts tight, especially in the built-up type of crossing.

In general, the running surface of a crossing can best be maintained by welding. If it is of manganese-steel construction, a portable electric-welding outfit provides an easy means of doing the necessary reconditioning. On the other hand, open-hearth crossings can be kept in condition more easily by means of the oxy-acetylene process.

The crushing of the running surface tends to tighten the track gage, which in turn helps to throw the crossing out of line. Furthermore, this action causes an undue strain on the bolts. Gage can best be maintained by grinding off the crushed and flowing metal. The maximum guard-face gage, as recommended by the A.R.E.A., which is 4 ft. 4-⅞ in., should be maintained, even though the track gage may vary somewhat from the standard.

As a rule, the line of crossings is subject to such a severe strain that it is extremely difficult to keep correct line. To facilitate doing so, the tracks approaching the crossing should be well-ballasted and anchored with an adequate number of anti-creepers. Even where this is done, however, more or less frequent attention must be given to the line.

In built-up crossings the greatest difficulty is experienced when the bolts are allowed to get loose, since this permits relative movement between the various parts of the assembly, and the rails tend to slip out of position. On this type of crossing, tight bolts probably assume first importance. Aside from the features already pointed out, the relative importance of the details requiring attention can hardly be stated. To maintain a crossing in first-class condition, every detail must be given close attention, since neglect of any one will react unfavorably on the others.

All Should Be Given Most Careful Attention

By Assistant Engineer Maintenance of Way

Basically, the maintenance of a railway crossing is no different from that of other parts of the track structure, in that the same requirements for drainage, for stable roadbed, for clean ballast of ample depth and for sound timber, apply to both. The differences, which are universally recognized, arise from the fact that the crossing is a highly specialized form of track construction, which is subject to more severe usage than other parts of the track.

Passing over these basic requirements for all track, ballast under crossings requires more frequent cleaning than that in ordinary track, especially on roads handling bulk commodities, such as coal, ore, sand, etc. The reasons for this are that two lines contribute materials that cause fouling, while the shock given to cars in passing over the crossings causes larger quantities of fine material to be shaken out in the crossing area.

Railway crossings fall into two general types, the manganese construction and the built-up rail type. While the general details of maintenance are the same for both, there are some sharply defined differences. In either type the attention given to bolts is important; in the built-up type it is paramount, since the life of the crossing may depend entirely on the standard to which they are maintained.

No overstatement can be made of the importance of good bolts, kept tight. That the importance of quality is generally recognized is evidenced by the fact that most specifications for new work are rigid in this respect. Yet I have known more than one case where ordinary bolts, sometimes of reclaimed materials, were used in replacement. Heat-treated bolts of the highest quality are none too good for a railway crossing, either for the original construction or for replacement. If the bolts are not kept tight, relative movement is set up between the parts of the assembly, excessive wear occurs, and in a short time the crossing cannot be kept tight by any expedient. As a further result, excessive battering of the rail ends is induced at the intersections of the flangeways.

Line and surface through a crossing are as essential as on any other part of the track and should be given the needed attention. Neither one can be maintained, however, unless other details are properly cared for. Distinguishing between ordinary surface and the running surface of the crossing, poor running surface results usually from wear, batter or external damage. This can usually be corrected by welding, using the electric arc for manganese steel and the oxy-acetylene process for open-hearth construction.

Gage often becomes a matter of concern in railway crossings, the tendency being for the gage to become tight. In a rail crossing, as the parts wear and the bolts are tightened, the rails are drawn in, thus decreasing the gage. About the only remedy in this case is to introduce a shim between the running rail and the filler, but as this is a difficult task requiring considerable skill, it is seldom done. The same difficulty is experienced with solid-manganese crossings, but in this case the trouble is generally caused by flowing metal. It can best be corrected by grinding off the rolled-out metal. Because of this tendency of the gage to become tight, some engineers have advocated a gage slightly wider than standard to allow for some take-up. Where this is done, however, extreme care should be exercised to insure that the guard-face gage is standard.

It would be extremely difficult to evaluate the relative importance of the various details that require attention in the maintenance of railway crossings. Most of them are so interdependent that neglect of any one is likely to have an unfavorable effect on the others. For this reason, I consider it desirable that every detail be given close and frequent attention, in which event the crossing as a whole will be kept in better condition and have a much longer life than otherwise.

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Flanger Signs, Where to Locate

Should flanger signs be erected at all turnouts, grade crossings, bridges, insulated joints, etc., or only at obstructions where there are no other identifying signs? Why? Is there any advantage in maintaining permanent flanger signs in territory subject to heavy snowfall? Why?

Does Not Consider Flanger Signs Necessary

By J. C. PATTERSON
Chief Engineer Maintenance of Way, Erie, Cleveland, Ohio

At one time flanger signs were considered to be necessary, locomotives were equipped with flangers as an auxiliary device. Enginemen who were not familiar with the characteristics of the road, which made the lifting of the flanger blades compulsory to avoid damage, were warned by the signs in ample time to lift the flanger. This method of flanging has proved to be an inefficient one, however, and on this road all flanging is now done with either special flanger cars or Jordan spreaders equipped for flanging.

These cars are provided with electric headlights whenever it is necessary to send them out at night, and they are in charge of the track supervisor or some other officer entirely familiar with the territory over which they are being run, while the operation is carried out with a clear view ahead.

There are practically no obstructions where there are not some means of identification which would be merely duplicated by the flanger sign. At grade crossings with public highways there are invariably highway crossing signs, and where there is any traffic on the highway the crossing is soon marked by this traffic. Insulated joints are indicated by the signals, relay boxes and posts or other apparatus. Likewise, bridges can easily be identified. Turnouts can be located by the switch stands; station platforms by the stations; and similar indication is given for other kinds of obstructions. For these reasons, we find only occasional necessity for the erection of flanger signs.

Should Be Erected at Every Obstruction

By BERNARD BLUM
Chief Engineer, Northern Pacific, St. Paul, Minn.

Flanger signs are placed for the express purpose of giving warning to the end that flangers may be raised to avoid striking obstructions when flanging rail to remove snow. It would appear, therefore, that they should be erected at all places where snow is likely to cover these obstructions. For these reasons, good practice dictates that flanger signs should be placed at turnouts, grade crossings, bridges and other obstructions where it is necessary that flangers be raised.

While state laws require adequate warning signs at grade crossings, these signs are usually painted white and the aspect from the track, when approaching the crossing, is such that they are rarely clearly visible when there is snow on the ground. Where heavy snow falls occur, switch stands and other identifying signs may be buried or hidden by drifts, but flanger signs are usually of such construction and are placed in such locations that they can easily be identified. There does not appear to be any good reason for protecting insulated joints with flanger signs, at least insulated joints of the types that are used on the road with which the writer is connected.

Permanent flanger signs are preferred for the reason that they can be placed to best advantage at uniform distances, so far as practicable, from the points of obstruction. Temporary flanger signs which are erected only during the winter months are usually less neat in appearance than permanent ones. There appears to be no saving possible in the use of temporary signs, and it is probable that the loss of material and the labor cost incident to setting them up and taking them down every year will result in a larger expenditure than that of providing neat permanent signs of metal.

Flanger Signs Should Be Distinctive in Design

By Division Engineer

Any one who has operated a flanger recognizes the urgent necessity of providing unmistakable indication of obstructions that require the lifting of the flanger blades. If prompt and reliable information concerning the presence of obstructions is not available to the operator of the flanger, damage to the equipment is certain and loss of life may occur. Flangers are usually operated under adverse conditions, and when this must be done during storms, the difficulties may be increased many fold. Where there is any doubt, therefore, about the adequacy of other signs, or any chance of confusing or misunderstanding them, the safe course is to erect a flanger sign. Obviously, to avoid the possibility of confusion with other signs or of misunderstanding the indication, flanger signs should be of distinctive design, unlike that of any other sign in use.

Specifically, they should be erected at every private crossing where the plank adjacent to the rail must be retained during the winter, and at every public crossing at grade. Wing fences and crossing warning signals are not easily discernible when the ground is covered with snow, and even when seen they may be deceptive as to location. Inside guard rails on ridges offer an obstruction which will damage or destroy the flanger blades unless they are lifted, and may cause a derailment if they are torn out.

While it may be thought that a switch stand will offer as sure an indication as a flanger sign, experience has shown that it is not always a safe one. In the first place, the stand may not be on the right side of the track to be seen; in the second place, it is better to have the indica-

tion far enough in advance of the obstruction to permit the flanger blades to be raised after it has been passed. Visability is often limited by the snow that is disturbed by the equipment, while if snow is falling or drifting, the view may be quite prescribed. Again, where switches are unlighted, a ground stand may not be seen, or may be seen on too short notice to permit raising the flanger, if it is being operated at night.

Formerly, the flanger blades did not clear some of the insulated joints in use, and it was necessary to provide indications for them. However, substantially all of the designs in use today clear the flanger blades, so that signs are unnecessary. If joints that will not clear are in use, signs should be erected to mark their location.

Personally, I do not favor the use of permanent flanger signs. This is a seasonal sign, required for only a few months of the year and serves no purpose during the remainder of the time. I believe in reducing the number of right of way signs to the absolute minimum. As it is, taking the system as a whole, an enormous number of signs are required on the right of way, and if any can be dispensed with, I think it better to do so. If flanger signs are properly designed, only a small amount of labor is required to erect and take them down. Also if they are left up during the summer, they may interfere with the use of mowing machines, spreaders and other right of way work to an extent that will more than offset the cost of erection and removal, while they certainly do not add to the appearance of the right of way.

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Loosening Bolts in Joints

Is there any advantage in loosening the bolts slightly at joints upon the approach of cold weather, to permit contraction of the rails? Why? If not, what means can be employed to insure the maintenance of uniform expansion gaps?

There Are Cases Where This May Be Desirable

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

It is no easy matter to maintain uniform expansion gaps, even where the track is maintained to a high standard and adequate anchorage is provided for the rail. The difficulties of doing so are increased as these standards are lowered. The use of heat-treated material affords an opportunity to tighten the bolts in joints to a tension that was unheard of only a few years ago, so that it is now an easy matter to "freeze" joints and eliminate all possibility of expansion movement of the rail through the joint bars.

Heavy angle bars, with their larger fishing surfaces and better support for the rails, have made it unnecessary, however, to employ extreme bolt tension in order to keep a joint in good condition, as was necessary with smaller sections and untreated bolts. Again, modern spring washers tend to minimize the wear on fishing surfaces and help to keep the joint tight with lower bolt tensions than can be used where they are not employed.

Assuming that at the time stipulated in the question the expansion gaps are uniform, the desirability of loosening the bolts will depend entirely on the bolt tensions that are being maintained. If the tension is so great that the rail cannot slip in the joints, then the bolts should be loosened just enough to allow this slippage to occur and thus provide for a continuance of uniform expansion gaps at all joints; otherwise, the tension that will be produced in the rail will be so great that eventually some joint will be found where the grip of the angle bars is not sufficient to overcome the pull of the rail and the bolts will be sheared. The best way to maintain uniform expansion is to anchor the rail adequately to overcome the tendency to creep and then watch your bolt tensions.

Does Not Favor Loosening Bolts

By O. SURPRENANT
Roadmaster, Delaware & Hudson, Schenectady, N. Y.

Aside from its function of supporting the rail, the joint is designed to permit ready movement of the rail in expansion and contraction under temperature changes. In many cases, however, this movement does not take place freely because of the ease with which the joints can be frozen with the heat-treated bolts and high pressure spring washers so commonly used today. If we loosen the bolts, however, we must accept the responsibility for battered rail and other damage that is likely to occur by reason of loose joints. One cannot trifle with a rail joint any more than he can with the hub nut of an automobile and still expect to keep within the bounds of safety.

Anti-creepers only retard rail creepage; they do not affect expansion and contraction. There are devices on the market, however, that not only arrest the creepage of the rail but affect the movement of the rail in expansion and contraction as well, since they hold it at every tie and thus prevent the accumulative effect of the tension or compression induced in the rail by temperature changes. For this reason, where these devices are in service, a light tightening of the bolts in the spring and again in the fall is all the attention that need be given to a joint, so far as the support of the rail by the joint fastening is concerned. In other words, the uniformity of the expansion gaps is assured without the necessity for loosening the bolts on the approach of cold weather.

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Painting Creosoted Lumber

Can creosoted lumber be painted? If so, how?

Creosoted Lumber Can Be Painted

By J. R. SCATTERDAY
Roadway Engineer, Engineering Advisory Committee, Chesapeake & Ohio, Cleveland, Ohio

It is sometimes necessary for the railways to increase the visability of certain of their structures which are built of creosoted material. This is particularly true of guard rail posts, poles and other structures. It is not generally practicable to use ordinary paints on creosoted wood, because the paint film soon becomes discolored and loses its visibility, but creosoted timber can be painted successfully. To do this, I recommend a single coat of aluminum paint over the creosoted surface after it has had an opportunity to weather. If the aluminum paint is applied to a freshly creosoted surface, however, the results will never be satisfactory.

When aluminum paint dries, the minute metallic flakes which form the pigment settle, one overlapping the other, to form a metal case sealing the underlying surface. The varnish vehicle is the controlling factor, however, in obtaining the desired results. The common varnish that is generally employed as the vehicle for paints will be far from satisfactory when applied over creosoted surfaces. For this reason, it is necessary to use a vehicle of what is known as the long-oil type, that is, one in which

the proportion of oil to gum is sufficiently high to give the varnish a high degree of elasticity combined with satisfactory hardness and drying time. The commonly-used spar varnishes are of the long-oil type, although, in general, the varnishes that will give best results when used with aluminum paint for applications over creosoted surfaces must be even more elastic than the average spar varnish. Long-oil varnish suitable as a vehicle for aluminum paint for use over creosoted materials can be supplied by any reliable paint manufacturer. If additional light reflection is desired, a coat of white paint can be applied over the aluminum paint.

Has Been 90 Per Cent Successful

By L. G. BYRD
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Assuming that the lumber to be painted has been treated a sufficient time to insure curing and a dry surface, creosoted material of either hardwood or softwood can be painted successfully with any standard grade of paint, provided it has received a priming coat, or better, two coats of aluminum paint. It is important, however, that the surface be dry and not subject to bleeding. If the surface contains an excess of creosote or of creosote and tar, it will be necessary to clean it off before the paint is applied. Usually this can be done by scraping it off with a paddle.

We have been painting mile-post numbers on creosoted telegraph poles, and other signs, for about five years and find the practice to be very satisfactory. When the practice was first started, we experimented with various combinations of paint and, naturally, had some failures. Despite this, however, approximately 90 per cent of the earlier signs are still in good condition, and practically all of the later ones are. Among these combinations, some of the signs were given a priming coat of aluminum paint, followed with two coats of white lead and oil.

Creosoted Surface Should Be Dry

By C. MILES BURPEE
Research Engineer, Delaware & Hudson, Albany, N. Y.

In general, creosoted lumber is used in structures where the application of paint is unnecessary. In planning the erection of a structure which will require the application of paint on lumber that has been given preservative treatment, it is well to select one of the clean treatments, such as zinc chloride, which can be painted successfully in any desired color.

Where it is desired to use creosote as the preservative, however, the use of aluminum paint has been attended by better results than have been obtained with any other paints that have been selected for this purpose. In making the application, the condition of the surface and the method of treatment have considerable bearing upon the success or failure of the job. If the Rueping, or empty-cell, process is employed, with a retention of 8 to 10 lb. of creosote per cu. ft., satisfactory results have been obtained by using a mixture of 2¼ lb. of standard-varnish aluminum-bronze powder to the gallon of vehicle. The latter should consist of a hard, dry, long-oil varnish, containing 50 per cent by weight of non-volatile oils and gum. The major portion should consist of heat-treated china-wood oil, and the remainder of heat-treated linseed oil. Such a mixture produces good leafing qualities. For best results, the paint should be mixed on the job just before the application is made.

At least 30, and preferably 60, days should elapse after the lumber is removed from the treating cylinder, to provide a period for drying, before the paint is applied. Satisfactory results cannot be obtained by painting material immediately after it is treated. Successful applications of paint of various colors have been made by using aluminum paint as a primer. Better results may be expected from painting lumber treated by the empty-cell process than by the full-cell process, since the surface of the former dries more quickly and there is less danger of blistering than where the latter process is used.

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Air in Suction Lines

What measures are necessary to prevent the introduction of air into suction lines?

Keep Pipe on Gradient Rising to Pump

By E. M. GRIME
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

There is usually a small quantity of air either dissolved in or mixed with water, and in the churning process incident to the flowing of the water to a pump, there is a tendency for the air to separate from the water and collect at any high point, resulting in an air pocket in the line. Air collected in this manner tends to constrict the available area of the pipe almost to the full extent of the space occupied by the air. While it might seem that the air should readily move along with the water, this does not happen. An air pocket also seems to increase the pipe friction when the pump is in operation, to an extent almost equivalent to an equal obstruction of solid material, or to an actual reduction in the size of the pipe approximately equal to the area of the air pocket.

For these reasons, it is desirable to construct a suction line in such manner that the upper surface rises steadily until it reaches the pump, thus leaving no place between the foot valve and the pump where air can collect. Where the usual reduction in the size of the suction line is made as it enters the pump, an eccentric reducer should be placed in such a way that the top is in a straight line with the pipe. If these precautions are taken, air will accumulate only in the top of the pump where it may be bled off by a hand-operated valve or some type of automatic air primer.

For the efficient operation of any type of pump, it is necessary that the suction line be maintained in absolutely air-tight condition. To this end, the foot valve should be in good working condition at all times and it should be placed at a sufficient distance below the surface of the water to preclude the possibility that eddies will form and air bubbles will be drawn into the line with the water.

Good Workmanship an Important Factor

By R. C. BARDWELL
Superintendent Water Supply, Chesapeake & Ohio, Richmond, Va.

Probably the most important measure in preventing the introduction of air into suction lines is good workmanship at the time of installation. In the American Railway Engineering Assocation's Manual of Recommended Practice, it is stated that genuine wrought-iron pipe with screw joints is preferred for suction lines. When installing such a line, special care should be exercised to insure that every joint is absolutely tight. To this end, red lead, graphite or other suitable jointing compounds can be used to advantage. The pipe joints should be made up full thread. In addition, the suction line should be laid with at least a slight upward grade

from the source of supply. Summits or sags which might entrain air pockets should be avoided, and the pipe should be blocked or otherwise supported adequately where subject to undue strains.

When the end of the suction pipe extends out into a river or small stream, it must be submerged deeply enough to prevent air being sucked in when the stream is at low stage. Our experience has indicated that best results can be obtained with the least submergence by using perforated pipe strainers having a total area of openings at least five times the pipe area, and a clearway swing check valve in the suction line, instead of the old style foot valve with a basket strainer, which usually has a diameter greater than the pipe.

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Renewing Caps in Trestles

How should one go about renewing a cap in an open-deck pile trestle? What precautions should be observed?

Finds Stirrups Very Convenient

By H. AUSTILL
Bridge Engineer, Mobile & Ohio, St. Louis, Mo.

In discussing this subject, I am assuming that hand work is referred to and that the stringers are two panels long. My method of replacement is, first, to provide stirrups, or clamps, designed to straddle a crosstie and with open ends which are bent to pass under the stringer and suspend it as the tie is lifted. Next, I set a jack on each end of the two caps adjacent to the one that is to be renewed, placing blocks on top of the jacks and under the ties in such a way that when the jacks are lifted, the load will be distributed about equally over two or more ties.

While this preparation is under way, one should remove all drift bolts through the stringers, or all cap-stringer fastenings, on the cap to be replaced and on the two adjacent caps where the jacks are set. Where bracing is connected to the cap, the fastenings for these members should also be removed. The next step is to place stirrups over the ties under which the jacks are set, sufficient stirrups being used to insure that every stringer over the three caps will be lifted as the jacks are raised.

As soon as these preparations are completed, the entire deck is jacked up until the stringers clear by several inches the cap that is to be replaced. The old cap is then removed in the quickest and most convenient way, and the new cap is brought to the site on a push car or monorail car. To get the cap into position, a ⅜-in. or ½-in. chain is placed about its center and the free end of the chain is snubbed around the rail. The cap is then tipped over the ends of the crossties, on the side of the bent away from the sway bracing, and the chain is slacked away until the cap is low enough to clear the stringers, when it is balanced horizontally. Then, if the pile heads are not treated, or protected, with materials that will be scraped off, the cap can be landed on one or more piles and lined up with the bent. To do this, a hand line is placed behind the end which is not projecting out, to drag it into position. It is then fastened to the piles, the deck is lowered and lined and the stringer fastenings are replaced.

If the dragging of the cap over the tops of the piles will scrape the treatment off of them, the cap should be balanced horizontally and transversely on the chain, and a hand line passed under each end to shift it under the deck until it is parallel to the bent. In this position it can be lifted to clear the piles and then shifted over the bent and lowered directly into position.

This same method might be used where all of the stringer ends join on the cap, provided the rail is stiff enough to carry the deck over the two panels. Otherwise, it will be best to use a two-panel length of timber under the ends of the ties and on top of the jacks. Obviously, if the trestle is low enough for men standing on the ground to handle the cap, it can be placed by hand from the ground more easily than from the deck.

Work of this kind should not be done except under flag protection, for which reason flagmen should be out in both directions from the beginning of the job until the structure is again ready for traffic.

May Be Necessary to Clamp Piles

By W. J. HOUSE
Bridge and Building Foreman, New Orleans & North Eastern, Poplarville, Miss.

When renewing a cap in an open-deck pile trestle, the first step is to place jacks on both sides of the deck on a bent adjacent to the one from which the cap is to be removed, for the purpose of lifting the deck to free the cap. By using two jacks of the proper capacity, with a 3-in. by 10-in. by 3-ft. plank, placed on each jack and under the bridge ties, this is easily accomplished. The next step is to remove all bolt fastenings from the cap and jack up the deck, taking the cap from the piles by means of pinch bars and cant hooks. The new cap is then placed on the deck immediately over the bent from which the old cap has been removed, and a timber hitch is made over the cap with a one-inch hemp rope, the other end of which is fastened to the guard timber with a winch hold. The cap can then be swung from the deck and lowered and shifted into place.

It is sometimes necessary to clamp one or more piles near the top to prevent them from kicking out of line when the drift bolts are pulled from the cap. This can be done by placing a 3-in. by 10-in. plank on each side of the piles and tying them together with bolts.

When installing caps on new structures, I find it an advantage to use a light derrick of my own design, for placing them. This derrick is mounted on a push car, and I have been able to place as many as 10 caps an hour, at an average cost of about $1 per cap.

Take Steps to Reduce Hazard

By L. G. BYRD
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Methods of renewing caps on open-deck pile trestles vary somewhat widely. Before describing the method which I believe to be the best and safest, however, I want to present a word of caution, because in my experience I have observed many instances of the improper use of tools, incident to the placing of jacks, the use of slings or raising clamps and the handling of the old and new caps. There is always a certain amount of hazard that cannot be avoided when men are working on the deck of a trestle, for which reason every precaution should be taken to reduce rather than increase the opportunities for personal injury.

If the height of the trestle does not exceed six or eight feet from the base of the rail and the ground is dry and firm, as much of the work as is practicable should be carried out from the ground, since this will reduce some of the hazards. This height will allow the jacks to be worked from below, and as they can be set up with greater facility, while some of the preparatory work otherwise necessary will be avoided, the time re-

quired for the work will be less and the cost of the work will be reduced proportionately.

It is quite necessary that the jacks be set level and that both chords be raised together. To accomplish this, footing blocks of ample area should be set under the jacks and shores should be placed over them to bear against a section of 4-in. by 8-in. plank having a length equal to the width of the chord, which should be placed transversely under the stringers. With this set-up, only two jacks will be required. After the chords have been raised, the old cap can be removed by hand from the ground. The new cap, however, can best be placed from the deck, by means of a hand winch mounted on a push car.

If the trestle is more than eight feet high, the jacks cannot be used on the ground, in which event the jacking must be done from the caps of the bents adjacent to the one involved in the renewal. To accomplish this, the jacks are placed so that the load of lifting will be distributed over several ties which are clamped to the stringers by means of 1-in. hook bolts which pass under the stringers and through 1-in. by 3-in. by 12-in. plates, each of which lies across the tops of two ties. It is generally necessary to use two of these bolts for each jack in order to distribute the load on the ties. In some cases the hook bolts are replaced by needle beams under the stringers, in which event the supporting bolts pass through a 3-in. by 4-in. by 14-in. wooden block over the tops of the ties. Regardless of the method of support, however, particular care should be exercised to insure that the ties are clamped securely to the stringers on both sides of the track on the bents upon which the jacking is to be done. All of the jacks, two to each bent, should be worked in unison to avoid disturbing the line.

Preparatory to making the lift, however, the drift bolts or other fastenings between the stringers and caps should be removed. After the deck has been raised, the old cap is removed and the new one placed by means of the hand winch, as before. If the hand winch is not available, the cap can be swung onto the piling by hand by using a 1½-in. manila rope, but this method sometimes disturbs the line of the track.

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Loose Rivets

Where rivets have become loose, what details should be given special attention when replacing them? Why?

Should Consider Cause of Loosening

By A. W. CARPENTER
Engineer of Bridges, New York Central, Buffalo and East, New York

Before beginning to replace loose rivets, it would be well to consider the cause of the loosening. If it has resulted from too much load, which must be continued, repetition of the loosening might be prevented by reaming the holes and using larger rivets, or by some other means of reinforcing. The condition of the holes should also be a matter for consideration. If they are enlarged, longer rivets of the original diameter are required, and it might be that, in this case, reaming will be desirable.

In removing the heads of the rivets involved in the replacement, care should be exercised to insure the minimum of injury to the connected material. Removal of rivet heads by skillful gas cutting probably insures the least injury to the connected material. Obviously, consideration should be given to the economics of the work of replacement, particularly to the methods and tools to be employed. In the event that only a few scattered rivets require replacement, it will not pay to transport and set up an air compressor, so that hand cutting and driving might be the cheapest method, and satisfactory from the standpoint of workmanship. Again, the use of "bottled air" might prove to be economical.

Cause Usually Determines Method

By GEORGE V. GUERIN, JR.
Assistant Bridge Engineer, Great Northern, St. Paul, Minn.

When loose rivets are discovered in any part of a metal structure, it is essential that the reason for their condition be ascertained. Loose rivets are usually the result of faulty workmanship, although occasionally they are the result of overstrain, caused by loads on the structure in excess of the design loading, distortion of the riveted joint by reason of settlement or other unforeseen movement of the structure.

Loose rivets may result from such faulty workmanship as (1) improper reaming of misfit holes; (2) driving the rivets at improper temperatures; (3) using rivets of improper length; (4) insufficient tightening of the joint with erection bolts before riveting; (5) using riveting equipment inadequate for the size of the rivets that are driven, including the use of plungers of improper length in pneumatic riveting hammers; (6) insufficient or excessive driving of the rivets; and (7) redriving on the rivets after they have become cold.

Computation of stresses will determine whether the rivets have loosened as a result of excessive loading. On the other hand, an inspection of the structure will usually disclose whether they have been loosened through distortion, settlement or similar conditions.

In the event that faulty workmanship, distortion or settlement which can be corrected, has caused the rivets to loosen, it will be satisfactory to remove the old rivets and replace them with new rivets of the same diameter. The old rivets should be removed carefully, however, by drilling out the rivet shanks if necessary, to avoid damage to the connected metal. If the holes are found to be poorly matched, a certain amount of reaming should be done before the new rivets are driven. If, on the other hand, an excessive amount of reaming is required, it may be desirable to use new rivets of larger diameter. In this connection, it should not be overlooked that the excessive reaming of holes may decrease the net section of the member to the extent that the strength of the connection is reduced.

It may happen that the replacement of one or two loose rivets in a joint will loosen several adjacent rivets. Where this occurs, it is an indication that the plates were not properly drawn up with erection bolts when the rivets were driven originally. In such cases it is sometimes expedient to remove all of the old rivets in the joint and thoroughly tighten the joint with erection bolts before the rivets are replaced.

If the rivets have become loose as a result of overstrain, the matter should be referred to the engineer in charge of design. Proper calculations will then be made to determine the correct method of strengthening the riveted joint. If these calculations show that it is impossible to obtain sufficient strength through the use of larger rivets, it may be practicable to provide additional rivets or to reinforce the joint by placing additional or larger connection plates, angles or other structural shapes.

Frequently, the replacement of rivets or the reinforcement of the joint may have to be done under traffic. In this event, it will be necessary to maintain proper strength by using erection bolts and drift pins in the open holes during the progress of the work.

NEW AND IMPROVED DEVICES

Linde Develops New Oxweld Cutting Blow-Pipe

THE Linde Air Products Company, New York, has developed a new oxy-acetylene cutting blow-pipe, known as the Oxweld type C-24 blow-pipe, which incorporates a number of interesting features of design and operation. It has been designed essentially to serve as a

The New Oxweld Type C-24 Blow-Pipe

general-duty cutting blow-pipe but is capable of doing heavier work if necessary, and will operate with less oxygen pressure than any previous Oxweld designs.

This new blow-pipe is equipped with what is said to be an entirely new type of cutting oxygen valve, which is placed in an easily accessible position. Other features include a long external cutting-valve lever, designed for convenient operation with the hand in the normal gripping position; nozzles with seat protectors; closer spacing of the heating orifices about the cutting oxygen opening; new nozzle sizes; and interchangeable ball-type inlet needle valves of large capacity. This blow-pipe may be obtained with either a low pressure injector or a medium-pressure mixer, which are interchangeable.

A New Front End Loader for Cletrac Tractors

A FRONT-END loader of unusual design has been developed by the Cleveland Tractor Company, Cleveland, Ohio, for application to its Cletrac tractors. An important feature of the loader is that it is mounted on the track frame in such a manner, it is said, that the transmission case, motor, motor frame and springs are relieved of shocks and stresses due to its operation.

As shown in the illustration, the loader embodies a bucket mounted rigidly between the curved ends of two lifting arms, which in turn are mounted over the crawler frames and actuated by inter-connected hydraulic cylinders. In order to secure an even distribution of the load over the lower track wheels, the supporting frame of each lifting arm is attached to the track-frame shaft, commonly referred to as the dead axle, and to the front end of the side frame.

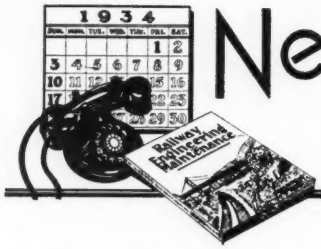
The lower end of each hoisting piston bears against a horizontal member, being free to rotate through a small angle in a vertical plane, while the upper end is attached to an inclined member which is pin-connected at one end to the front end of the horizontal member and at the other end to the lifting arm. The lower ends of the lifting arms are free to slide back and forth along tracks fastened to the horizontal members as the bucket is raised and lowered. With this design it is said that with the bucket empty the tractor remains in balance without the use of counterweights.

The New Front End Loader for Application to Cletrac Tractors

The telescoping cylinders, using oil as a medium, are of the self-sealing packed type, hydraulic pressure being supplied by a full roller bearing pump. It is pointed out that the use of a hoist on each side of the tractor eliminates any twisting action that might otherwise be present.

The bucket may have a capacity of either 14 or 20 cu. ft., depending on the size of the tractor. The bottom of the bucket is hinged at its inner end and the load is discharged by pulling on a cord.

SMALLEST RAILROADER—Bud Evans (colored), special porter for the Gulf, Mobile & Northern at McLain, Miss., is the world's smallest railroader. At the age of 52 years he is 27 in. high and weighs about 60 lb. Bud has had many flattering offers to join circuses but he has turned them all down.



News of the Month . . .

Tie Reinstalled After 46 Years of Service

Unearthed recently after 46 years service in a track at a charcoal kiln at Hermansville, Mich., a cedar tie was found to be in such an excellent state of preservation as to warrant its installation in another track, where it is expected to give 15 to 20 years additional service. The tie had been used with 60-lb. rail in a cut about 4 ft. deep where it had lain in moist soil during the 46 years. In its original location the tie was not provided with tie plates and as a result ½ in. of wear occurred at the rail seats. Provided with tie plates, it is now laid in track with 80-lb. rail.

Fire Losses Hit New Low in 1933

Fire losses on the railways of the United States reached a new low for the last 10 years in 1933 when they totaled $4,243,534, as compared with the previous low of $5,104,430 established in 1932, according to figures presented at the annual convention of the Railway Fire Protection Association at Chicago on October 16-17. In 1924 fire losses reached a high for the 10-year period when they amounted to $11,580,005. In 1933, the average number of fires per road was 78.2, as compared with 86.8 in 1932 and 117.9 in 1930. In 1933, trespassers were responsible for fire losses totalling $649,448, or more than was attributed to any other single cause. Fires attributed to the improper construction, installation and maintenance of stoves caused damage amounting to $130,293. Enginehouses and blacksmith shops, with a combined loss due to fire of $323,392, showed the largest loss of any single classification of fixed property.

Advocate Use of PWA Funds for Crossing Elimination

Allotment of $1,400,000,000 of public works funds for the elimination of 25,694 railway grade-crossings in Eastern states, which would require more than 9,000,000 man-months of labor, is urged in a letter to Harold L. Ickes, administrator of public works, by Milton W. Harrison, president of the Security Owners Association, an organization of holders of railroad securities. Not only would 90 per cent of such expenditures go directly into wages, the letter said, but they would be spent in congested areas where unemployment is greatest and public purchasing power the lowest. "On economic grounds," it said, "as well as public safety required through widespread use of motor vehicles, grade crossing elimination is becoming increasingly important. The railroads stand on the threshold of a new era of high speeds. The advent of newly-designed trains, traveling at high speeds, has made 'stop, look and listen' signals obsolete. In the modernization of transportation, overpasses or underpasses for highway traffic are a vital part of the highways."

Florida Canal Not Practicable Says Army Engineers Report

An unfavorable report on the project for the construction of a ship canal across Florida has been made by a special board of army engineers and PWA representatives that was appointed to review the project. The board reported that the canal could earn operating and maintenance expenses, but would not retire a bond issue, even at a two per cent interest rate, within a reasonable period. The loan necessary for construction of the canal could not be repaid without interest in less than 80 years, the report said. The board had reported previously that the cost of a 30-ft. sea level canal would be $143,000,000, exclusive of interest during the six-year period of construction.

Rail Net for Eight Months Above Last Year

Class I railroads of the United States for the first eight months of 1934 had a net railway operating income of $300,702,141, which was at the annual rate of return of 1.88 per cent on their property investment, as compared with a net of $280,848,913, or 1.74 per cent, in the same period of 1933, according to reports compiled by the Bureau of Railway Economics. Operating revenues for the eight months amounted to $2,188,560,046, as against $2,006,077,467 for the same period in 1933, an increase of 9.1 per cent. Operating expenses totalled $1,632,477,088, compared with $1,466,447,454 for the same period in 1933, an increase of 11.3 per cent.

In August these railroads had a net of $39,677,357, or 1.39 per cent, as compared with $61,401,986, or 2.13 per cent, in August, 1933. Operating revenues for August amounted to $282,679,430, as compared with $297,030,894 in August, 1933, a decrease of 4.8 per cent. Operating expenses for the month were $211,706,258, compared with $202,470,716 in the same month in 1933, an increase of 4.6 per cent.

Eastman Favors Regulation of Motor Carriers

Joseph B. Eastman, federal co-ordinator of transportation, reiterated his views that all motor carriers should be regulated by the Interstate Commerce Commission where they engage in Interstate Commerce, in an address before the National Association of Motor Bus operators at Cleveland, Ohio, on September 21. It has been the experience throughout the world, he said, that it does not pay to leave transportation to the free play of unregulated competition and "the government must see to it that this public business is preserved from disorder and waste and that it furnishes good service to all on equal terms and at reasonable and dependable rates.

"If the users do not bear their fair share of the capital cost and maintenance of the highways," Mr. Eastman said, "they ought to do so. My staff has been working on that subject for some months, and I expect before long to issue a report which I believe will be both interesting and illuminating. It is a fact that the highways are responsible each year for a huge toll of killed and injured, and that public safety needs far more protection that it now gets. I believe, also, that the rates and service of motor carriers for hire should be publicly regulated."

Another High-Speed Train for the Union Pacific

The second light-weight, high-speed passenger train ordered by the Union Pacific from the Pullman Car & Manufacturing Corporation has been completed and delivered to the railroad which plans to place it in transcontinental service between Chicago and the Pacific coast. While the first train has 3 cars, the new one is a 6-car articulated unit, comprising a power car, a mail-baggage car, 3 sleepers and a coach-buffet car. It is the first Pullman-equipped streamlined passenger train to be placed in service in this country. The new train, which is of aluminum-alloy construction practically throughout, is 376 ft. long and weighs 210 tons, including all equipment, fuel, water, etc., which may be compared with a weight of about 700 tons for an equivalent conventional steam train. The car is expected to demonstrate the practicability of saving an entire business day in railroad service between Chicago and the Pacific coast.

Tie Stocks on September 1 Show Increase

Reports filed with the Railway Tie Association by 14 companies supplying about 85 per cent of the crossties produced by commercial firms show that these companies had 6,797,886 crossties on hand September 1. This was 278,961, or 4.3 per cent, more than these companies had on hand on August 1, and also an increase of 1,312,014 ties, or 23.9 per cent, as compared with the number of ties on hand on September 1, 1933. Of the ties available on September 1, 4,316,127, or 63.5 per cent, were 8 ft. long and 2,481,759, or 36.5 per cent, were 8 ft. 6 in. long. U-ties for use untreated totaled 510,041, or 7.5 per cent of the total inventory, while oak ties for treatment totaled 4,525,135, or 66.6 per cent of the total. All other species for treatment totaled 1,762,710 ties, or 25.9 per cent of the inventory.

The largest number of ties in stock was reported by the district comprised of Kentucky, Tennessee, Alabama, Mississippi and Louisiana east of the Mississippi river, the number being 2,793,190. The smallest number, 75,359 ties, was reported by the district which includes Michigan, Wisconsin and Minnesota.

Association News

The Wood Preservers Association

The executive committee met at Chicago on October 3 to complete the details for the convention which is to be held at the Hotel Pennsylvania, New York, on January 22-24, 1935. At this meeting it was reported that the program is now complete and characteristic of the high character that has prevailed heretofore. Also, the Transportation committee was instructed to endeavor to formulate an itinerary for those members coming to the convention from the west which would enable them to visit some treating plant east of Chicago enroute to New York.

Bridge and Building Association

At a meeting of the newly-elected executive committee on Thursday evening, October 18, immediately following the conclusion of the convention, the following subjects were selected for consideration by committees during the next year:

The Use of Treated Timber in Buildings.

The Cleaning of Steel Bridges Preparatory to Repainting.

The Inspection of Bridges and Buildings in the Light of Today's Deferred Maintenance.

The Welding of Pipes in Water Supply, Plumbing, etc.

Types of Floors for Highway Bridges Under Various Service Conditions, With Relation to Durability, Character of Sub-Floor Required, Cost and Surface Characteristics.

The Relative Merits of Different Types of Pumping Equipment and the Conditions Under Which Each Is Most Suitable.

Under-Water Inspection and Examination of Railroad Structures.

Coincident with the resumption of full activities, the executive committee voted to restore the dues to the regular rate of $4 in place of $2 which has been in effect since the discontinuance of the conventions.

National Railway Appliances Association Formulates Plans for Exhibit

At a meeting of the executive board of the National Railway Appliances Association at Chicago on October 22, called to fix the date for the allotment of space for the exhibit which will be held at the Coliseum, Chicago, on March 11-14, 1934, during the convention of the American Railway Engineering Association, it was decided that this date should be fixed as November 12. On that date the Executive committee will allocate space to member applicants.

Seventy companies have qualified for membership to date, 40 of whom have already filed applications for space while some 20 additional applications are in process of filing, several of these companies applying for larger amounts of space than they took at the last exhibit.

With the American Railway Engineering Association returning to a three-day convention and with the expectation that the Signal division, American Railway Association, will again meet in Chicago as it did last March, it is expected that the exhibit will again take on the interest that formerly attached to it as an essential feature of engineering week in Chicago.

American Railway Engineering Association

During October, activities in this association consisted largely in shaping up and putting the final touches on committee reports, one of which is already in the hands of the secretary, while one or two others are expected in a few days. Thirteen committees held meetings during October, 12 of which were final, and 8 of which were held in Chicago. Those held in Chicago were Wood Preservation, and Waterways and Harbors, on October 2; Shops and Locomotive Terminals, on October 16; Water Service, Fire Protection and Sanitation, on October 16 and 17; Economics of Bridges and Trestles, on October 18; Wooden Bridges and Trestles, on October 19; and Signals and Interlocking, and Rules and Organization, on October 26. Those held at other points were Uniform General Contract Forms, at New York, on October 1; Yards and Terminals, at Philadelphia, Pa., on October 1 and 2; Economics of Railway Location, at Pittsburgh, Pa., on October 2; Iron and Steel Structures, at Philadelphia, Pa., on October 4 and 5; and Waterproofing of Railway Structures, at Baltimore, Md., on October 18 and 19.

Three committees have meetings scheduled for November, while several others are planning to hold meetings on dates not yet selected. Those already scheduled for this month are Waterways and Harbors, at Chicago on November 2; Buildings, at Savannah, Ga., on November 8 and 9; and Economics of Railway Operation, at New York, on November 22 and 23.

The mailing of the 1934 Proceedings was completed on October 12.

R. F. C. Loans to Railroads

The Reconstruction Finance Corporation, up to August 31, had disbursed $413,675,144 in loans to railroads, of which $70,486,162 had been repaid.

Freight Cars and Locomotives on Order Show Increase

Class I railroads on September 1 had 8,372 new freight cars on order, as compared with 1,129 on the same date in 1933 and 1,423 on the same date two years ago, according to reports compiled by the Car Service division of the American Railway Association. On September 1 these railroads had 35 new steam locomotives on order, as compared with 1 on September 1, 1933, and 5 on the same date in 1932.

In the first eight months of 1934, the railroads installed 14,970 new freight cars, as against 1,838 in the same period in 1933 and 2,477 in 1932. Six new steam locomotives were placed in service in the first eight months, as compared with 1 in 1933 and 35 in 1932.

Personal Mention

General

H. G. O'Leary, division engineer at the Lakehead division of the Canadian National, with headquarters at Ft. William, Ont., has been appointed acting superintendent of that division with the same headquarters, succeeding **R. S. Richardson,** who has retired.

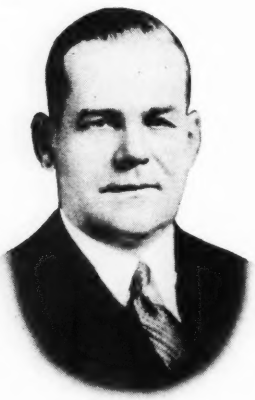
Samuel R. Hursh, division engineer on the Pittsburgh division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been promoted to superintendent of the Wilkes Barre division, with headquarters at Sunbury, Pa., succeeding **Charles G. Grove,** who has been appointed superintendent of passenger transportation of the Eastern region, with headquarters at Philadelphia, Pa. Mr. Grove was also at one time a division engineer on the Pennsylvania.

Richard H. Aishton, chairman of the Association of Railway Executives and chairman of the board of the American Railway Association, whose railway experience included many years in the engineering department of the Chicago & North Western, has retired following the consolidation of these two associations to form the Association of American Railroads. Mr. Aishton was born on June 2, 1860, at Evanston, Ill., and entered railway service in 1878 as an axman in the engineering corps of the North Western, serving successively as a rodman, levelman, assistant engineer, superintendent of bridges and buildings, and division engineer until 1895. In that year he was transferred to the operating department as assistant superintendent, being advanced to division superintendent two years later. Mr. Aishton was promoted successively to general superintendent, assistant general manager, general manager, and in 1910 to vice-president in charge of operation and maintenance. In 1916, he was elected president of the North Western. During the war he was made regional director of the Northwestern region of the United

Richard H. Aishton

States Railroad Administration. In 1920 he was elected president of the American Railway Association and four years later he was elected also chairman of the executive committee of the Association of Railway Executives. Mr. Aishton was elected chairman of the board of directors of the A.R.A. in 1933, retaining this title and that of chairman of the Executive Committee of the Association of Railway Executives until his retirement.

Horace C. Grout, general superintendent on the Canadian Pacific at Toronto, Ont., and formerly an assistant division engineer with this company, has been promoted to assistant to the vice-president at Montreal, Que. Mr. Grout was born on March 14, 1881, at Wausau, Wis. He was educated at Northwestern Military Academy and the University of Wisconsin, and entered railway service



Horace C. Grout

in 1898 with the Canadian Pacific as a rodman in the construction department, later becoming an instrumentman and then a resident engineer. From 1904 to 1910 he served as a resident engineer with the maintenance of way department and as assistant division engineer at Toronto. He served as assistant superintendent at Havelock, Ont., and Toronto, Ont., from April, 1910, until February, 1912. From the latter date until October, 1912, he served as superintendent successively at Toronto and Brownville Junction, Me., and in October, 1912, he became assistant general superintendent of the New Brunswick district at St. John, N. B., later becoming general superintendent of this district. He was appointed general superintendent of the Ontario district at Toronto, Ont., in April, 1920, and served in this capacity until his recent promotion.

Engineering

E. E. Mayo, assistant engineer on the Southern Pacific, Pacific Lines, has been promoted to the newly-created position of assistant chief engineer, with headquarters as before at San Francisco, Cal., **Paul T. Robinson,** division engineer of the Tucson division, with headquarters at Tucson, Ariz., has been promoted to engineer maintenance of way and structures, with headquarters at San Francisco, succeeding **William M. Jaekle,** whose death was noted in the October issue. **J. B. Dawson,** assistant division engineer of the Rio Grande division at El Paso, Tex., has been promoted to division engineer at Tucson to succeed Mr. Robinson, and **W. W. Winn** has been appointed assistant division engineer at El Paso, replacing Mr. Dawson.

Mr. Mayo has been connected with the Southern Pacific for more than 27 years. He was born on September 13, 1885, at Springfield, Mo., and received his technical training at the University of Oregon. He entered railway service in February, 1907, as a levelman on location for the Pacific Railroad & Navigation Company (now part of the Southern Pacific), later serving as a transitman and resident engineer on construction for the same railroad. When this company was taken over by the Southern Pacific in 1912, Mr. Mayo was appointed an assistant engineer on the staff of the district engineer maintenance of way and structures of the Northern district of the Southern Pacific, being promoted to roadmaster on the Portland division in July, 1913. Seven years later Mr. Mayo was

E. E. Mayo

further advanced to assistant division engineer of the Salt Lake division, and in October, 1920, he was promoted to division engineer of the Portland division, being transferred to the Sacramento division in May, 1922. From November, 1923, to May, 1926, he served as assistant engineer in charge of second track construction in the Sierra Nevada Mountains. From May to July of the latter year he was on special duty, assisting engineering forces in the construction of new lines on the Southern Pacific of Mexico. Following the completion of this assignment he was appointed assistant engineer at San Francisco, which position he was holding at the time of his recent appointment as assistant chief engineer.

Mr. Robinson was born on February 12, 1882, at Hubbard, Iowa, and was educated at Rose Polytechnic Institute, Terre Haute, Ind. He entered railway service with the Union Pacific in June, 1900, serving as an axman, rodman, instrumentman and draftsman until July, 1905, when he was appointed assistant engineer on construction, serving in this capacity until December, 1906, when he was appointed chief draftsman. Mr. Robinson entered the service of the Southern Pacific in January, 1908, serving as office engineer and assistant engineer on the Sacramento division until January, 1912, when he was appointed a roadmaster on the same division. In September, 1913, he was transferred to the Stockton division as assistant division engineer. From March to December, 1917, Mr. Rob-

Paul T. Robinson

inson served as engineer for the assistant general manager at Los Angeles, Cal., then being appointed special engineer in the general manager's office at the same point. In May, 1918, he was appointed assistant division engineer of the Los Angeles division and during federal control of the railroads, he served as division engineer of the San Joaquin division. At the end of this period Mr. Robinson was appointed assistant division engineer of the Western division, being promoted to

J. B. Dawson

division engineer of the East Bay Electric division, with headquarters at Oakland, Cal., in January, 1922. In November, 1923, he was advanced to division engineer of the Tucson division, which position he was holding at the time of his recent appointment as engineer maintenance of way and structures.

Mr. Dawson was born on May 13, 1881, and was educated at Hiram College. He first entered railway service in April, 1900, as a tapeman on the Chicago, Mil-

waukee, St. Paul & Pacific, then serving in various capacities in the engineering departments of this company, the Erie, the Chicago, Burlington & Quincy and the Lonowata Mining Company, Wickensburg, Ariz., until January, 1910, when he entered the service of the Southern Pacific as an assistant engineer. In November, 1917, he was promoted to division engineer, holding this position until April, 1922, when he entered the contracting business at Stockton, Cal. In November of the same year he returned to the Southern Pacific as assistant engineer, being advanced to assistant division engineer in November, 1923. Five years later he was promoted to division engineer and in August, 1930, he was made assistant engineer on construction of the Southern Pacific's Bonito dam. In July, 1933, he was appointed assistant division engineer of the Rio Grande division, which position he was holding at the time of his recent appointment as division engineer at Tucson.

Special

C. E. Morgan, inspector for the superintendent of work equipment and welding of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to superintendent of work equipment and welding, with headquarters as before at Chicago, succeeding **M. D. Bowen,** who has

C. E. Morgan

resigned. Mr. Morgan was born on September 30, 1904, at Strang, Neb., and was educated in electrical engineering at the University of Wyoming and the University of Idaho. He entered the service of the Milwaukee Road in July, 1927, as a special apprentice in the locomotive department at Milwaukee, Wis. Early in 1930 he worked for three months as a test observer on the Nickolson Syphon test of a Mikado type locomotive, and in May, 1931, he went to the University of Illinois to act as a special research assistant in connection with a test on car wheels and brake shoes. On the completion of this work in June, 1932, Mr. Morgan returned to the shops at Milwaukee where he remained until January 16, 1933, when he became an inspector for the superintendent of work equipment and welding. He was holding this position at the time of his recent appointment.

Track

Vernon Scobie, a track foreman on the Pere Marquette at Flint, Mich., has been promoted to roadmaster with headquarters at Saginaw, Mich., succeeding **R. J. Diener,** who remains as roadmaster at Saginaw in place of **F. D. Harrigan,** whose death is noted elsewhere in this column under Obituary.

H. B. Rutherford has been appointed assistant supervisor of track on Subdivision 32 of the St. Lawrence division of the New York Central, with headquarters at Malone, N. Y. **L. M. Knopp** has been appointed assistant supervisor of track on Subdivision 30, with headquarters at Rochester, N. Y.

Bridge and Building

Charles W. Boyce, who has been appointed supervisor of bridges and buildings on the Yazoo & Mississippi Valley (part of the Illinois Central System), with headquarters at Vicksburg, Miss., as noted in the August issue, was born on November 16, 1881, at Chesterfield, S.C. He entered railway service in September, 1906, as a carpenter on the Vicksburg, Shreveport & Pacific (now part of the I.C. System), where he was advanced to bridge and building foreman on October 7, 1912. On February 13, 1916, Mr. Boyce went with the New Orleans & Northeastern as tie agent, returning to the V.S. & P. in the following year. In March, 1918, he was made tie agent with the latter company, being appointed a bridge and building foreman on December 1 of the same year. Five years later Mr. Boyce was promoted to assistant supervisor of bridges and buildings of the V.S. & P., and the Alabama & Vicksburg (now also part of the I.C. System) and on June 2, 1926, he was further advanced to supervisor of bridges and buildings of the Vicksburg Route division of the Y. & M.V. From October 16, 1931, until his recent appointment he served as bridge and building foreman.

Obituary

F. D. Harrigan, roadmaster on the Pere Marquette at Saginaw, Mich., died on September 29.

Albert H. King, retired supervisor of bridges and buildings on the Union Pacific at Salt Lake City, Utah, died on September 24 at Oak Park (Chicago), Ill.

R. W. Mitchell, general foreman of bridges and buildings on the Baltimore & Ohio, with headquarters at Mt. Clare, Md., died on September 25 following a stroke.

E. G. Ericson, who retired in 1927 as assistant chief engineer of the Pennsylvania System, with headquarters at Pittsburgh, Pa., died on September 22 at his home at Sewickley, Pa.

Louis J. Anderson, who retired on June 1, 1923, as supervisor of bridges and buildings of the Peninsula division of the Chicago & North Western, with headquarters at Escanaba, Mich., died at his home in Lantana, Fla., on September 26.

Supply Trade News

Personal

Frederick Crosby, vice-president and treasurer of the **American Hoist & Derrick Company,** St. Paul, Minn., has been elected president to succeed **Frank J. Johnson,** who has resigned. **Harold O. Washburn,** general superintendent, has been appointed vice-president and treasurer to succeed Mr. Crosby.

V. L. Conley, assistant district manager of the Cleveland (Ohio) sales district of the **American Rolling Mill Company,** Middletown, Ohio, has been transferred to the Pittsburgh (Pa.) district as assistant district manager in charge of a new sales office opened in 17 Court Street building, Buffalo, N. Y. This office will have charge of all the territory in New York State from Utica west. **A. W. Bryant,** with headquarters at Rochester, N. Y., will assist Mr. Conley.

The Socony-Vacuum Oil Company, Inc., New York, has organized a Railroad division to direct the sales of petroleum products in that field. Railroad sales, under this new arrangement, will be under the general direction of **P. M. Gordon,** manager, Industrial Lubrication division, who will be assisted by **Earle Welborn.** In the eastern field the sales and engineering organization will be headed by **R. R. Vinnedge** with office at 26 Broadway, New York City. **John E. Ferry,** at Chicago, will be in charge of the company's railroad business in the middle and far West.

Trade Publication

Portable Air Compressors—The Ingersoll-Rand Company, New York, has issued a 12-page attractively printed booklet describing and illustrating this company's line of portable air compressors. In addition, the gasoline and oil engines with which these compressors are powered are described and a complete list of the products of this company is given.

Expect Larger Carloadings in Fourth Quarter

Freight carloadings in the United States in the fourth quarter of 1934 will be 2.2 per cent greater than for the same period of 1933, according to estimates compiled by the thirteen shipper's regional advisory boards. On the basis of these estimates, loadings of the 29 principal commodities will amount to 4,618,359 cars in the last quarter of this year, as compared with actual loadings of 4,520,780 cars of the same commodities in the corresponding period of 1933. Ten of the thirteen boards anticipate that carloadings in their respective regions will show increases in the last quarter, while the other three expect decreases. The largest increase (9.1 per cent) is expected to take place in the Pacific Coast region.

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